

KODIAK MANAGEMENT AREA SALMON RESEARCH
OPERATIONAL PLANS FOR 1993

Regional Information Report¹ No. 4K93-23

**Alaska Department of Fish and Game
Division of Commercial Fisheries
Management and Development
211 Mission Road
Kodiak, Alaska 99615**

June 1993

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OPERATIONAL PLAN
KODIAK MANAGEMENT AREA
CATCH SAMPLING, 1993



Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska 99615

May 1993

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INTRODUCTION

The Kodiak Management Area extends from Imuya Bay on the south to Cape Douglas on the north and includes Shelikof Strait and the waters of Kodiak, Afognak, and Shuyak Islands (Figure 1). The area includes 454 specified salmon streams and lakes. The management area is divided into seven districts and 98 statistical areas. The districts and statistical areas are established to facilitate specific stock management.

Five Pacific salmon species are harvested in the Kodiak Management Area. Sockeye salmon are economically the most important species followed by pink, chum, coho, and chinook salmon. The 1992 catch was 4,167,700 sockeye, 3,310,500 pink, 679,500 chum, 280,100 coho, and 24,299 chinook salmon. The total harvest was 8,462,100 fish. The 1993 harvest is projected to be 2,370,000 sockeye, 290,000 coho, 21,575,000 pink, 1,200,500 chum and 21,000 chinook salmon.

The Alaska Department of Fish and Game assumed the responsibility of managing Alaska's salmon resources in 1960. The goal has been to manage the resource for maximum sustained yield. Generally, achievement of this goal is accomplished by: 1) setting and implementing escapement objectives by system which will produce the greatest number of harvestable fish and; 2) deriving techniques necessary to assist fishery managers in obtaining escapement goals and optimum harvest. Assignment of catch to river system of origin is a prerequisite for evaluating escapement objectives and forecasting stock returns. In 1985 an expanded salmon commercial catch sampling operation was initiated in the Kodiak Management Area for establishing a data

base for determining stock contribution levels, evaluating escapement goals, and forecasting. The program has continued since with the current emphasis on sockeye salmon.

GOAL

Provide improved management of the Kodiak Management Area (KMA) salmon runs.

OBJECTIVES

1. Construct accurate brood tables.
2. Develop accurate run forecasts.
3. Evaluate escapement goals and accurately define run timing.
4. Estimate the composition of sockeye stocks harvested in non-terminal (interception) fisheries.
5. Estimate the contribution of Upper Cook Inlet sockeye salmon to the July fishery within the KMA.
6. Determine the accuracy of recorded fish ticket weights for sockeye salmon.

TASKS

1. Collect representative age composition data from selected sockeye fisheries.
2. Sample selected sockeye catch deliveries for average fish weight.

SUPERVISION

Charles Swanton will supervise the catch sampling at the Port of Kodiak, Larson Bay, and Alitak Bay.

PERSONNEL

Personnel assignments at the Port of Kodiak, Larson Bay and Alitak Bay are defined in Table 1. Available permanent and seasonal staff will assist in catch sampling at the Port of Kodiak.

PROCEDURES

Catch Sampling For Age

Sockeye salmon catches will be sampled for age by the crew at the Port of Kodiak, Larson Bay and at Alitak according to the schedules in Table 2.

All catch sampling data are to be representative and random. To ensure that this occurs mixed loads from non-targeted areas are not to be sampled, and there is to be no pre-selection of fish for length, sex, condition, or any other factor.

To ensure that sockeye samples are not missed, the crews will begin sampling the first day of delivery from the designated sampling areas each week (Table 2).

The standard procedures for collecting and recording salmon age data are defined in Appendix A. The accuracy of the data and scale sample quality will be the responsibility of the crew leaders. If questions or problems arise, do not hesitate to inquire with your supervisor for clarification or assistance.

Periodically inseason, the Alitak crew will send their completed (original) opscan forms and scale impression acetates to the Kodiak office for final processing. Correspondence should be directed to Patti Nelson. The crew leader will notify the Kodiak office by radio that the data are being sent, and will maintain a log book of all out-going samples. The original scale cards and copies of the opscan forms should be hand carried to town at the end of the season. All scales collected by the Alitak crew will be pressed at Lazy Bay prior to being mailed to Kodiak. Additionally, all scales collected through 15 July will be aged (by Leslie Scott) before being sent to Kodiak. An updated copy of the sampling log (Figure 2) should be sent weekly to the Kodiak office.

Each crew leader should review the Kodiak Management Plan contained in Appendix B.

At the end of the season the Alitak crew leader will inventory all gear at the camp and send to Kodiak that gear which needs repair. The State rifle is the only equipment that must be returned to Kodiak. All other equipment can be locked up on-site.

Age Determination

Ageing of scales will be conducted only by certified scale readers. As of 10 June, those certified to age scales are: Bruce Barrett, Patricia Nelson, Charles Swanton, and Leslie Scott.

Weight Sampling

Sockeye salmon catch deliveries from six tenders will be sampled weekly in July to determine average fish weight (Table 2). The total number of fish weighed per sampled tender load will be 600. The 600 fish will be weighed and recorded separately in two 300 fish aggregates. (Figure 3). While sampling will be done opportunistically, a reasonable attempt will be made to ensure that individual tenders and catch areas are not sampled more than once each week; also in sampling, there will be no preselection or bias for or against tenders which are delivering from multiple catch and/or mixed gear type areas.

A copy of the tender log sheet, listing the fish ticket receipts for each particular load sampled, will be included with each two-300 fish weight sample. The weekly sampling effort will be evenly distributed between the crews operating at the Port of Kodiak, Larson Bay, and Alitak.

Table 1. Salmon catch sampling crew for Kodiak Management Area, 1993.

Location	Name	Title	PCN	Position	Period
Port of Kodiak	C. O. Swanton	FB II	1273	Crew Leader	9 Jun - 31 Aug
Alitak	Leslie Scott	FB I	1413	Crew Leader	9 Jun - 15 Jul
	Bruce McIntosh	FT III	1594	Crew	7 Jun - 15 Jul
	Bruce McIntosh	FT III	1594	Crew Leader	16 Jul - 31 Aug
Larson Bay	Millie Gray	FT III	1312	Crew Leader	9 Jun - 1 Jul
	Ken Bouwens	FT III	1827	Crew Leader	1 Jul - 31 Jul
	Leslie Scott	FB I	1413	Crew Leader	1 Aug - 31 Sep

Table 2. Sockeye salmon catch sampling schedule for the Kodiak Management Area, 1993.

Crew	District/Section	SAMPLING AREA		Season	Freq.	SAMPLE	Data	Fishery
		Geographic Area	Statistical Area			Size ^a		
Port of Kodiak								
	Afognak District, ^b							
	Shuyak Is. Section & NW Afognak Section	Point Banks to	251-30 through 70	Jul 6-25	Weekly ^c	600 ^d	Scales	Mixed-stock
	SW Afognak Section	Raspberry Cape	251-10, 20	Jul 6-25	Weekly ^c	600	Scales	Mixed-stock
	Mainland District ^b							
	Dakavak Section	Dakavak Bay	262-10 through 55	Jul 6-25	Weekly ^c	600	Scales	Mixed-stock
	Outer Kukak Bay Section	to						
	Hallo Bay Section	Cape Douglas						
	Big River Section							
	Katmai and Alinchak Sections		262-60 through 70	Jul 6-25	Weekly ^c	600	Scales	Mixed-stock
	Eastside Kodiak District							
	Sitkalidak Section	Dangerous Cape to Cape Kasiak	258-10 through 53	Jul 6-25	Weekly ^c	600	Scales	Mixed-stock
	KMA	all	all	Jul 6-25	Weekly ^a	2-(600 ea)	Weights	Mixed-stock

Alitak								
	Mainland/Cape Igvak	Imuya Bay to Cape Aklek	262-70,80,90,95	Jun 9-Jul 25	Weekly	480	Scales	Mixed-stock
	Alitak Bay/Cape Alitak	Cape Alitak	257-10,20	Jun 9-Aug 31	Weekly	600	Scales	Mixed-stock
	Alitak Bay/Moser Bay	Moser/Olga Bay	257-40,41	Jun 9-Jul 15	Weekly	600	Scales	Mixed-stock
		Moser/Olga Bay	257-40,41	Jul 15-Aug 31	Weekly	600	Scales	Terminal
	S.W. Kodiak/ Inner, Outer Ayakulik	Red River	256-10,20	Jun 9-Aug 31	Weekly	600	Scales	Terminal
	S.W. Kodiak/Halibut Bay	Halibut/Gurney Bay	256-30,25	Jul 6-Jul 25	Weekly	600	Scales	Terminal
	KMA	all	all	Jul 6-25	Weekly ^a	2-(600 ea)	Weights	Mixed-stock

Larson Bay								
	N.W. Kodiak/Central	Uyak Bay ^f	254-*. *	Jun 9-Sep 16	Weekly	600	Scales	Mixed-stock
	N.W. Kodiak/Central	Uganik/Viekoda Bays ^f	253-*. *	Jun 9-Aug 31	Weekly	600	Scales	Mixed-stock
	KMA	all	all	Jul 6-25	Weekly ^a	2-(600 ea)	Weights	Mixed-stock

-Continued-

Table 2. (page 2 of 2)

-
- ^a If the required 600-fish sample is not practical to obtain, reduce sample size to 480 fish.
- ^b The goal is to obtain a 600-fish weekly sample from: (1) NW Afognak and Shuyak Island Sections combined; (2) the SW Afognak Section; and (3) the Dakavak Bay to Cape Douglas reach of the Mainland District. When no pure samples are available from these areas, a combined Mainland and Afognak Districts 1,200-fish sample should be taken.
- ^c Sample each opening if there is more than one opening per week.
- ^d Exclude fish caught terminally at Thorshiem from the mixed stock sample. However, estimate the number of fish caught terminally for each opening; if possible obtain a pure terminal sample (600 fish-ALS) aside from the regular mix-stock fishery samples.
- ^e Weekly sampling should include two 600 fish samples (made up of two 300 fish subsamples).
- ^f Primary sample site is Larson Bay; secondary sample site in Port of Kodiak.

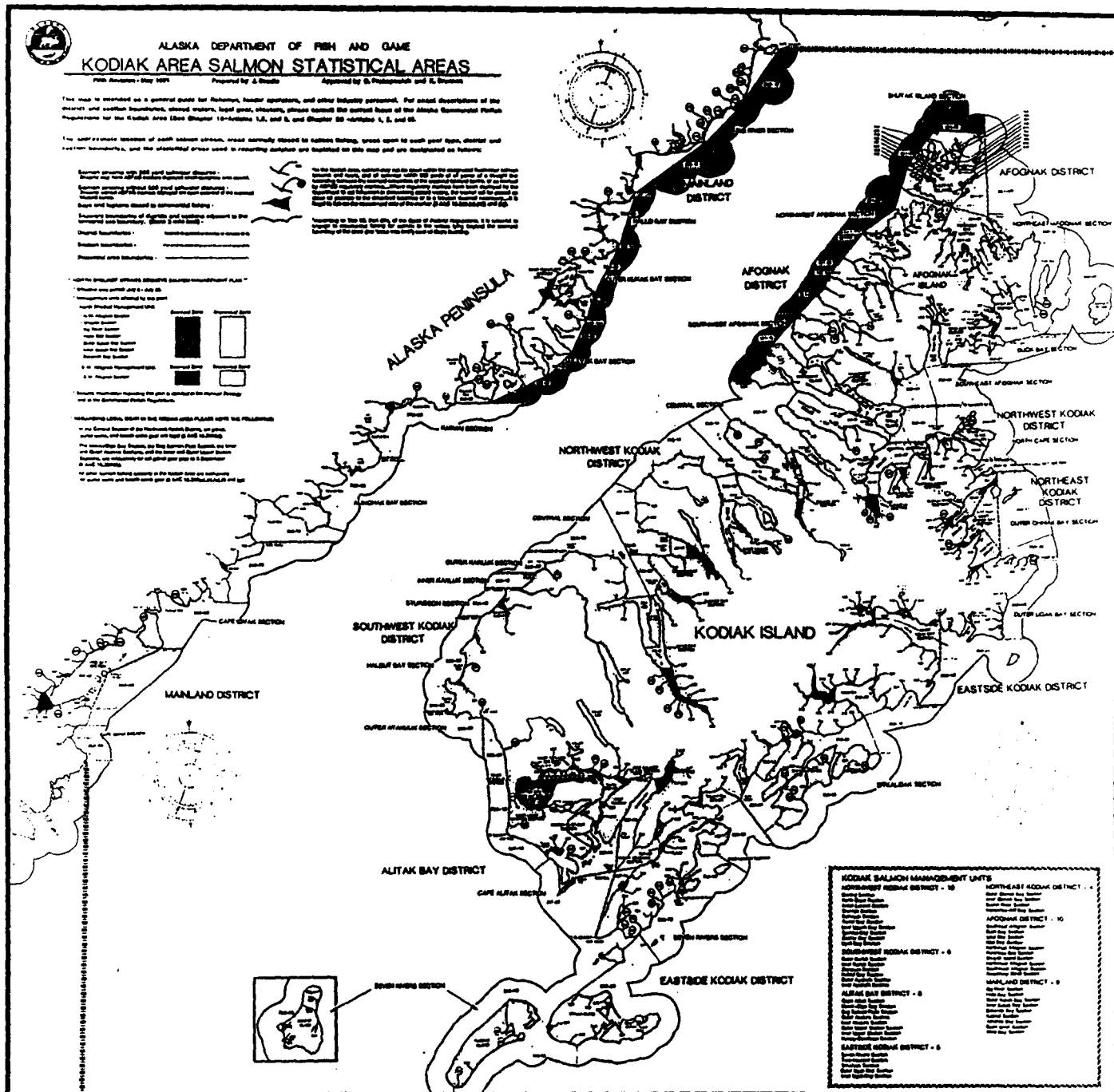


Figure 1. Kodiak Management Area districts and statistical areas, 1993.

[illegible]

Figure 3.

SOCKEYE SALMON WEIGHT SAMPLING RECORDING FORM

TENDER: _____

CATCH DATES: _____

 TENDER SHEET ATTACHED: YES or NO
 Circl One

DELIVERY DATE: _____

TOTAL (SOCKEYE) REPORTED DELIVERY WEIGHT: _____

PROCESSING PLANT: _____

TOTAL (SOCKEYE) REPORTED NUMBER: _____

SAMPLING CREW: _____

CATCH AREA: _____

SAMPLE ^a	TOTAL # OF SOCKEYE	GROSS WEIGHT ^b (FISH, CONTAINER, ETC.)	BASKET WEIGHT ^b (CONTAINER, ICE, ETC.)	NET WEIGHT ^b (FISH)
1				
TOTAL				
2				
TOTAL				

^a Obtain 2-300 fish samples.^b Specify weight units (pounds, kilograms, etc.)

APPENDIX A

**Procedures for Sampling Adult
Salmon for Age, Length, and Sex**

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix A.1. Similar examples for sampling chinook and coho salmon are shown in Appendix A.2.

Complete each section of the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:

Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:

The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye and chum scale samples will have only 1 gum card per AWL form as shown in Appendix A.1. Coho and chinook samples will use up to four gum cards per AWL form as shown in Appendix A.2.

Species:

Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:

Use appropriate digits for the date the fish are caught.

District:

List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):

List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:

Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:

List the appropriate code as shown on Appendix A.3.

Period:

List the period in which the fish were caught (Appendix A.4.).

Project and Gear:

Refer to the reverse side of the AWL form for the correct code.

Mesh:

Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:

Use (2) mid-eye to fork-of-tail. Refer to Appendix A.5.

of cards:

Mark 1 (each AWL form in individually numbered) when sampling sockeye, chum, coho, and chinook salmon.

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices A.1 and A.2.

Species:

Write out completely (i.e., chinook, sockeye, etc.).

Locality:

For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:

Transfer the appropriate digits from the AWL form.

Gear:

Write out completely.

Collector(s):

Record the last names of person(s) sampling.

Remarks:

Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:**A. GENERAL**

1. Place the fish on its right side to sample the left side.
2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.
3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix A.5.) Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy.
4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix A.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.
5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix A.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix A.7).
6. When sampling sockeye and chum salmon, repeat steps 1 through 4 for up to 40 fish on each AWL form.

7. When taking multiple scales per fish as with chinook and coho salmon, sample the "preferred scale" and scale #2 as shown in Appendix A.6. Scale #2 is one inch to the left of the "preferred scale," and is 2 rows above the lateral line. Mount the 2 scales from fish #1 over 1 and 11 on the gum card as shown in Appendix A.2. Continue to mount the 2 scales from fish #2 over 2 and 12, etc. If sampling 3 scales, mount the scales over #1, #11, #21, etc.
8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.**

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.
2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.
3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.
5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor.
6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.
7. If AWLs get wrinkled or splotted they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.
8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.
9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.
10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.
11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Species SOCKEYE Card No. 001
 Locality: AKALURA ESC.
 Stat. Code 257-30-302
 Sampling Date: Mo 08 Day 16 Year 91
 Gear: BEACH SEINE
 Collector(s): HICKS KAPLAN PEARSON
 Remarks: _____

10	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11
30	29	28	27	26	25	24	23	22	21
40	39	38	37	36	35	34	33	32	31

DESCRIPTION: SOCKEYE/AKALURA/ESC.

SAMPLES = HICKS, KAPLAN, PEARSON(R)

ADFG ADULT SALMON AGE-LENGTH
FORM VERSION 2.1

CARD: 001

SPECIES: 2

DAY: 16

MONTH: 09

YEAR: 91

DISTRICT: 257

SUBDISTRICT: 30

STREAM: 302

LOCATION: AKALURA

PERIOD: 34

PROJECT: 3

GEAR: 2

MESH:

TYPE OF LENGTH MEASUREMENT: 2

NUMBER SCALES/FISH: 1

OF CARDS: 1

SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1					
2					
3					
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100					

DO NOT WRITE IN THIS MARGIN

229518

litho
code

NCS ODCUSCAN* M826 17877 16 A4208

SPECIES

- 1 - Chinook (king)
- 2 - Sockeye (red)
- 3 - Coho (silver)
- 4 - Pink (humpy)
- 5 - Chum (dog)

PROJECT

- 1 - Commercial catch
- 2 - Subsistence catch
- 3 - Escapement (tower, weir, snor site, etc)
- 4 - Escapement - spawning grounds
- 5 - Test fishing
- 6 - Sport catch (marine)
- 7 - Sport catch (freshwater)

GEAR TYPE

- 8 - Trap
- 9 - Purse seine
- 10 - Beach seine
- 11 - Herring purse seine
- 12 - Handpicked
- 13 - Dip net
- 14 - 16 Unassigned
- 15 - Beam trawl
- 16 - Shovel
- 17 - Wier
- 18 - 30 Unassigned
- 19 - Pots
- 20 - Sport hook and line

Species COHO Card No 001A
 Locality KARLUK ESC
 Stat Code 255-10-101-
 Sampling Date Mo 08 Day 29 Year 91
 Gear WEIR / TRAP
 Collector(s) T. STACK, S. BROWN, J. FOX
 Remarks 2 SCALES / FISH

card: 001A

10	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11
30	29	28	27	26	25	24	23	22	21
40	39	38	37	36	35	34	33	32	31

DESCRIPTION: COHO / KARLUK / ESC
2 SCALES / FISH

SAMPLERS:
T. STACK - W
S. BROWN - P
J. FOX - A

ADF&G ADULT SALMON AGE-LENGTH
 FORM VERSION 2.1

CARD: 001A#8

SPECIES: COHO

DAY: 29

MONTH: 08

YEAR: 91

DISTRICT: 255

SUBDISTRICT: 10

STREAM: 101

LOCATION: 35

PERIOD: - 35

PROJECT: ESC

GEAR: WEIR / TRAP

MESH:

TYPE OF LENGTH MEASUREMENT: 2

NUMBER SCALES / FISH: 2

OF CARDS: 1

SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
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40					

DO NOT WRITE IN THIS MARGIN

216854

NCS DOCUSCAN M820-17877 109 AS200

Species COHO Card No 001B
 Locality KARLUK ESC
 Stat Code 255-10-101-
 Sampling Date Mo 08 Day 29 Year 91
 Gear WEIR / TRAP
 Collector(s) T. STACK, S. BROWN, J. FOX
 Remarks 2 SCALES / FISH

card: 001B

10	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11
30	29	28	27	26	25	24	23	22	21
40	39	38	37	36	35	34	33	32	31

Appendix A.3. Assigned port and weir location codes.

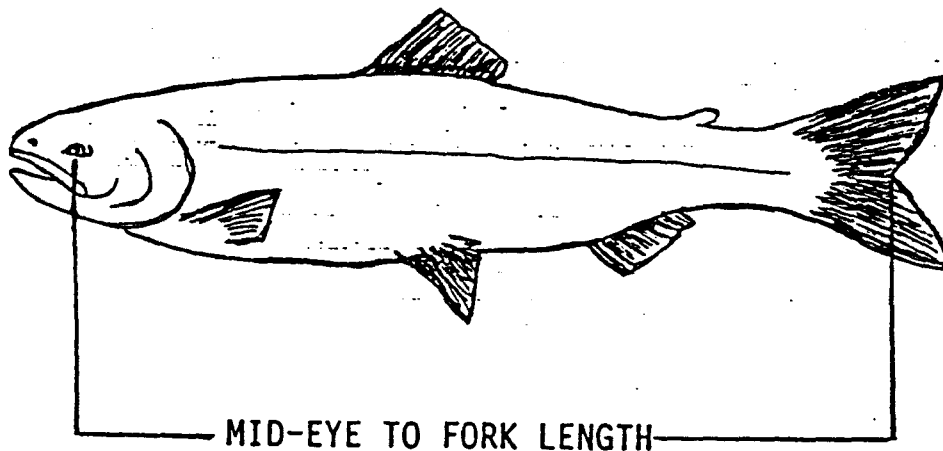
Port and Location Codes

030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix A.4. Periods and corresponding calendar dates, 1993.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Sep
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

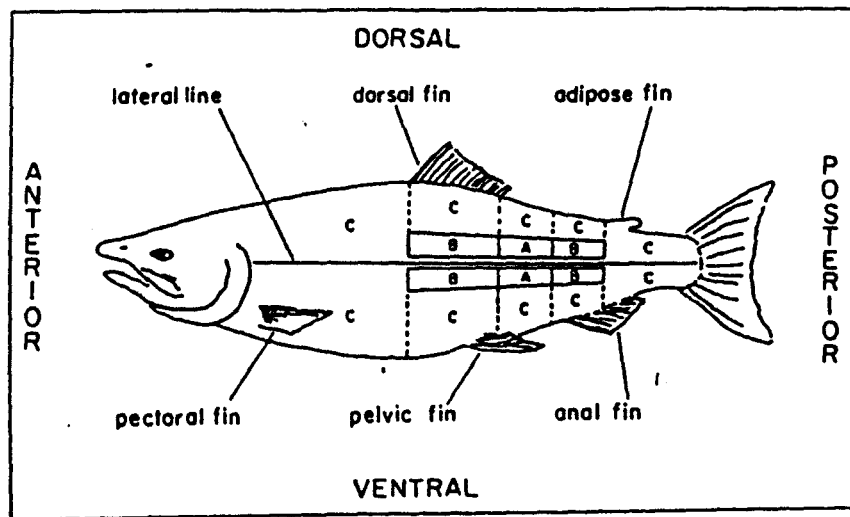
Appendix A.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

- 1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.
- 2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.
- 3) Flatten and spread the tail against the board with your right hand.
- 4) Read the mid-eye to fork length to the nearest millimeter.

Appendix A.6. Removal and mounting of the preferred scale.

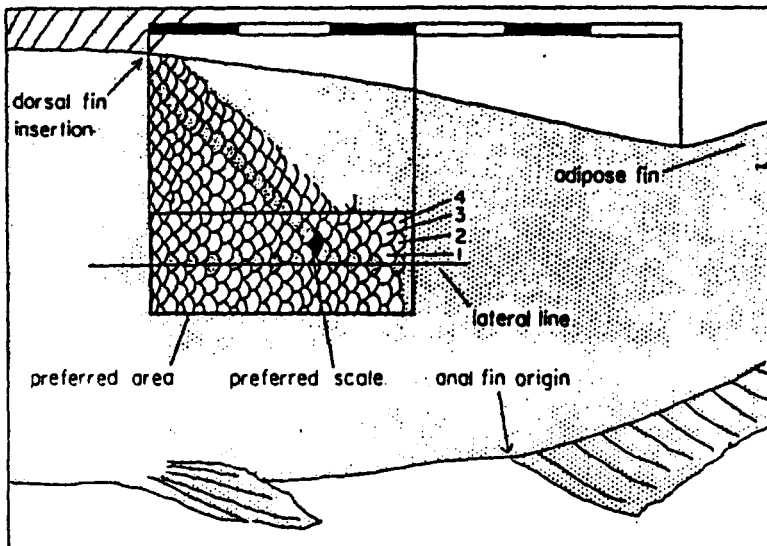


INPFC rated areas for scale removal.

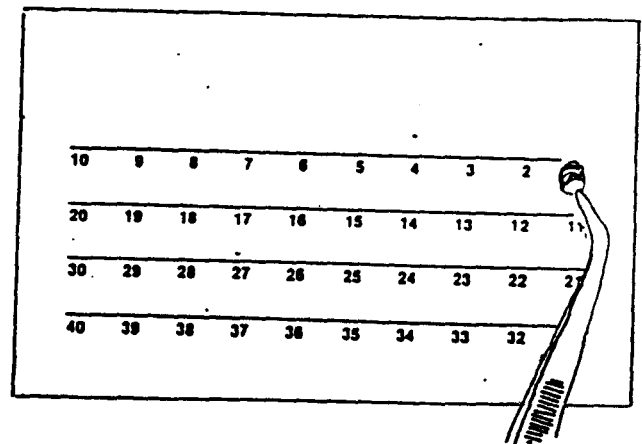
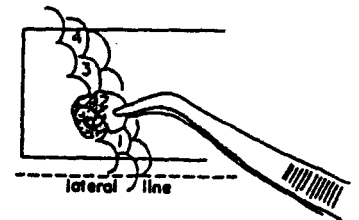
Area A is the preferred area. B is the second choice if there are no scales in area A.

C designates non preferred areas. If scales on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER



The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

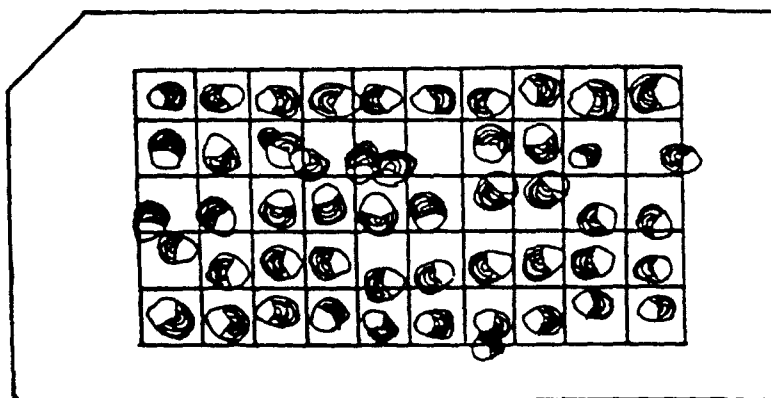


Place the scale directly over the number on the gummed card with the anterior portion (arches of the scale pointed toward the top of the card.

Appendix A.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

APPENDIX B

Kodiak Area Commercial Salmon Fishery
Harvest Strategy, 1993

KODIAK AREA COMMERCIAL SALMON FISHERY
HARVEST STRATEGY, 1993

By:

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Regional Information Report¹ No. 4K93-21

**Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska 99615**

May 1993

¹The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

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INTRODUCTION

In 1993, commercial salmon fisheries in the Kodiak Management Area (Area K) will be managed according to a harvest strategy which emphasizes three criteria:

- (1) **To ensure that 1993 salmon escapement occurs in the proper magnitude and distribution so that the potential for maximum production of future returns is established.**

The results of ADF&G's 1993 management activities will directly affect the following future commercially targeted returns:

- 1995 pink salmon
- 1996 - 1997 coho salmon
- 1996 - 1998 chum salmon
- 1997, 1998, 1999 sockeye and chinook salmon

- (2) **To provide for orderly fisheries on the highest quality salmon by maximizing harvest opportunities during each fishing period.**

This requires a species oriented approach.

- For sockeye and coho salmon from major systems, management emphasizes the use of inseason weir escapement data to determine fishing time by geographical area.
- Fishing time on minor sockeye and coho systems without fish weirs is determined by ADF&G's perception of run strength for these systems.
- Managing pink and chum salmon returns emphasizes using preseason forecasts initially to determine fishing time and then adjusting fishing time inseason as the actual run strength becomes more apparent.

- (3) **To adhere to the biological and allocative requirements of all State Board of Fisheries (BOF) Management Plans, in order to ensure that traditional fishing opportunities for all commercial gear types and all user groups occur in a manner consistent with the criteria identified in (1) and (2).**

This harvest strategy is an overview of how ADF&G expects to manage the 1993 salmon fishery. Along with this overview, a basic management chronology (Figure 1) can be used as a guide to clarify why inseason adjustments in harvest strategy are needed, as dictated by species specific management requirements. For example, sockeye salmon management requires fishing time and areas open to fishing be strictly regulated by the sockeye salmon escapement information obtained from up to nine salmon weirs. Prorating fishing time for sockeye salmon solely on the basis of preseason expectations, other than for the June 9 commercial test fisheries, is not an acceptable method of managing Kodiak's sockeye salmon stocks. However, for pink salmon management, prorating fishing time based upon preseason expectations is mandatory for prosecuting Kodiak's pink salmon fishery successfully. This can be done with little chance of adverse effects on future production and is the most acceptable way of managing the harvest of Kodiak's relatively large

pink salmon returns. Chum and coho salmon require a blend of these two management approaches in that both species are initially harvested as bycatch in fisheries where fishing time is generally targeted on pink salmon. Targeted management and stock specific fisheries on chum and coho salmon requires proper run strength assessment before these fisheries can occur. This requires a combination of both weir and aerial escapement data and assessment of fish "buildups". This information can be used, along with inseason assessment of bycatch of these species, to determine if the returns can adequately support additional near terminal harvests.

HARVEST PROJECTIONS

Initial projections for the 1993 Kodiak commercial salmon fishery are for a harvest of approximately 25,294,500 salmon (Table 1). This includes harvests of approximately 21,000 chinook, 290,000 coho, and 1,200,000 chum salmon. Up to 15,000,000 wild stock and 6,500,000 Kitoi Bay hatchery produced pink salmon should also be harvested. This could be a record for an odd year pink salmon harvest; this good forecast is based on excellent pink fry overwinter survival and favorable weather during the spring of 1992 when fry were outmigrating into the nearshore ocean environment. Sockeye salmon harvested should only be near 2,200,000 fish. This is lower than the harvest of recent years. The relatively weak sockeye forecast is in part due to lower than average expected returns to the Ayakulik River and Frazer Lake systems. Both the early and late run sockeye fisheries are expected to harvest near 1.1 million sockeye salmon (Table 1).

In 1993, in addition to the pink salmon produced at the Kitoi Bay Hatchery, enhancement projects conducted by the Kodiak Regional Aquaculture Association (KRAA) and ADF&G's Fisheries Rehabilitation and Enhancement Division (FRED), should contribute to the common property fisheries of the Kodiak Area. Supplemental production may allow for up to 22,000 sockeye, 5,000 chum, and 11,200 coho salmon to be harvested (Table 2).

A good tool for illustrating the timing and magnitude of salmon harvests are projected harvest graphs (Appendix A.1 - A.3.). A curve can be drawn, based on the historical average cumulative salmon catch by date, that is scaled to the current preseason harvest projection. By keeping track of the actual salmon harvest by date, and plotting these on the graphs, a comparison of expected and actual return can be made. These graphs are used for planning purposes by both ADF&G and industry to identify if preseason management or operational strategies need to be modified inseason because of unexpected deviations in actual run strength.

FISHING PERIODS

All fishing periods will be by emergency order and will generally be based upon inseason assessment of actual run strength (Table 3).

Opening Times

All regular fishing periods will begin at 12:00 Noon and end at 9:00 P.M., except:

- The Cape Igvak fisheries will usually begin at 12:01 A.M. and end at 12:01 A.M. during the period of June 6 through July 25.
- The Inner Ayakulik Section fisheries will usually begin at approximately low tide. These will be daylight openings, and will be initiated by ADF&G "flare openings". When such openings occur, the opening time for the Outer Ayakulik Section may be adjusted to coincide with the Inner Ayakulik Section.
- Beginning on August 16, all fishing periods will end at 6:00 P.M. instead of 9:00 P.M.

Advance Notice for Each Fishing Period

- All advance notice time will be based upon the initial announcements being made on SSB frequency 4125 Khz, following the **6:00 P.M.** daily marine weather broadcasts.
- For the **Cape Igvak fishery**, the initial fishing period will have at least a **36 hour advance notice**. All subsequent fishing periods will have at least 18 hours advance notice, unless it is an extension of an ongoing fishing period.
- For the **June sockeye fisheries** in the Alitak, S.W. Kodiak, and N.W. Kodiak Districts, the **initial fishing periods** will have at least a **42 hour advance notice**; this includes the normal June 9 fishing period for the Alitak and N.W. Kodiak Districts and the approximate June 14 fishing period for the N.W. Kodiak District.
- All subsequent fishing periods for the Kodiak Area prior to July 6 will have at least 18 hours advance notice.
- For the initial pink/chum salmon fisheries, at least 42 hours advance notice will be provided, with the fishery starting at 12:00 noon on July 6.
- All subsequent fishing periods for the Kodiak Area after the July 6 fishing period will have at least 18 hours advance notice.
- All extensions in fishing time from a previously announced fishing period will have at least 3 hours advance notice.

In Period Closures

- During the period July 6 through July 25 in period closures of "Seaward Zones" designated in the North Shelikof Strait Sockeye Salmon Management Plan may occur. Fishers who are fishing in management units covered by this plan are advised that in

period closures of "Seaward Zones" are possible and that such closures will be announced on SSB frequency 4125 at 8:00 A.M., 10:00 A.M., 2:00 P.M., or 6:00 P.M. with the effective closure time occurring three hours following the initial announcement time.

Length of Fishing Periods

Sockeye Salmon

In general, each fishing period targeting on early and late sockeye salmon runs to all major systems will be dependent upon weir escapement counts. This will also apply to those minor "weired" systems targeted by the commercial fishery.

The exceptions to this will be the normal June 9 commercial test fisheries in the Alitak Bay and N.W. Kodiak Districts. The first period will extend from 12:00 Noon Wednesday June 9 through 9:00 P.M. Thursday June 10, a 33 hour period. A second 33 hour commercial test fishery will occur in the N.W. Kodiak District on approximately June 14 depending upon when this fishery can be coordinated with other terminal sockeye fisheries in order to spread the fishing effort. Additional fishing time in the Alitak Bay District will depend on the results of the June 9 commercial test fishery, the ADF&G test fishery, weir escapements and positive buildup trends (see Alitak Bay District Management Plan).

In conjunction with this second commercial test fishing period in the N.W. Kodiak District, will be a potential 33 hour fishing period for healthy minor sockeye salmon systems (Afognak Lake, Saltery, etc.). Specific management units (sections) open for this fishery will be dependent upon the strength of the runs associated with these units. The E.O. announcement for this opening will specify which sections are to be opened.

Fishing periods in the Cape Igvak Section will continue to be in increments of 24 hours running from 12:01 A.M. to 12:01 A.M.. Fishing time will be dependent upon an evaluation of the Chignik System sockeye salmon run, the predominant contributing stock harvested in this section. A review of the Cape Igvak management plan listed in this document should clarify the biological and allocative requirements of this plan. For the 1993 season, fishing time will initially be allocated in the Cape Igvak Section based upon the criteria listed in paragraph (c) of the plan.

For most late run sockeye salmon stocks, a portion of the harvestable surplus is commonly taken as bycatch during targeted pink salmon fishing periods. Consequently, a "blended" management strategy is needed to insure minimum escapements are achieved by species with desired escapement requirements not being exceeded. The Westside Kodiak Management Plan provides an overview of which salmon stocks and time periods are targeted for management.

Pink Salmon

The total 1993 projected pink salmon harvest of 21.6 million fish, which includes Kitoi Bay Hatchery's projected contribution of 6.5 million pinks, represents a potential record high harvest. Overall, preemergent fry densities from the 1991 brood year were the highest on record for an odd year return. Mild spring weather conditions, combined with the overall high live fry densities, are the main factors which resulted in the 1993 pink salmon run being forecast at near record levels. It should be noted that during the previous three years (1990, 1991, 1992) pink salmon returned to Kodiak Area streams at less than forecasted levels. For the 1992 return, poor early marine conditions may have been the main factor for the less than expected return. In 1990 and 1991 there were very low adult average weights, which points to poor ocean rearing conditions. If similar marine conditions exist that may have affected the 1990 and 1991 returns, the 1993 pink salmon run may be less than projected. For planning purposes the actual harvest could approach the lower end of the forecast range of 15 million pink salmon, and may not exceed the point estimate of 21.6 million pink salmon.

The 1993 harvest strategy for pink salmon will emphasize the three management criteria identified in the introduction of this document.

In consideration of the forecasted strength of the 1993 pink return and the expected strong early production associated with odd year returns, the 1993 pattern of fishing periods for those management units where pink salmon are the targeted management species is expected to vary in fishing time from 4-1/2 days per week up to 7 days per week from July 6 through approximately August 25.

Listed below are projected fishing period scenarios which can be used for planning purposes by both ADF&G and industry. Changes in these scenarios should be expected if significant deviations in the actual pink salmon return occurs. Less fishing time should be expected in management units where chum salmon are the targeted management species.

First Period: 4-1/2 days (105 hours) - 12:00 Noon July 6 through 9:00 P.M. July 10. In recent years this initial fishing period has varied between 2-1/2 to 4-1/2 days in duration. Due to the expected strong early production associated with an odd year return a longer initial fishing period is warranted. This period provides harvest data important for early run strength assessment for Area K's entire pink salmon run as well as for specific chum salmon stocks. No extensions in fishing time based on pink or chum salmon harvests would occur during this period. In consideration of the run out tides, closed waters will be increased in the Inner Uganik Bay Section beginning with this fishing period.

Second Period: 4-1/2 days (105 hours) - 12:00 Noon July 13 through 9:00 P.M. July 17. This second period will help ensure that early run pink salmon stocks and several major chum salmon stocks are adequately harvested per the stated management goals, and that at least minimum escapements are ensured. Assessment of run strength for both species will emphasize harvest data. No extensions in fishing time based on pink or chum salmon harvests would occur during this period.

Third Period: 4-1/2 days (105 hours) - 12:00 Noon July 20 through 9:00 P.M. July 24. This third period will occur following a two day closure, to allow an influx of pink and chum salmon into terminal areas to enhance the build-up of potential escapement fish. This is the first fishing period when the combination of harvest and early escapement/build-up information will provide the initial indications of actual run strength for major pink salmon fisheries. While no extensions in fishing time are expected during this period, the assessment results of this period have commonly resulted in reduced fishing time during the fourth period for years of weaker than expected pink salmon returns.

Fourth Period: 4-1/2 days (105 hours) - 12:00 Noon July 27 through 9:00 P.M. July 31. This fourth period is a very critical period in that the peak harvest dates and a fairly accurate assessment of total run strength should be evident by period's end. Extensions in fishing time commonly occur off of this period during years when the pink and chum salmon returns are equal to or stronger than expected. The initial pink salmon opening for the Kitoi Bay Section should occur at the beginning of this fishing period.

Fifth Period: 4-1/2 days (105 hours) - 12:00 Noon August 3 through 9:00 P.M. August 7. This fifth period should yield the peak harvest date and should be the peak harvest period in 1993, provided normal run timing occurs. If preseason expectations appear valid, extensions in fishing time could occur in portions of the management area. This period commonly yields the first significant announcement of differential fishing time by management unit as heavy production areas are targeted for extensions, while moderate or lower production areas are not. Extensions in fishing time are not expected for management units located in the N.W. Kodiak District.

Sixth Period: 4-1/2 days (105 hours) - 12:00 Noon August 10 through 9:00 P.M. August 14. This sixth period should be the first postpeak period and is important from the standpoint that returns to major late production systems should be evident by period's end. Also this is a critical period for considering expansions in closed water sanctuaries to enhance escapement levels, and to make a final evaluation of run strength to determine if further reductions in fishing time are needed for the remaining periods to ensure adequate escapement; a strategy for "topping off" escapement for all systems stems from this period.

Seventh Period: 4-1/2 days (102 hours) - 12:00 Noon August 17 through 6:00 P.M. August 21. This seventh period is when a blended, multi-species management approach is needed for those sections where pink salmon were the targeted species for the previous six periods. Emphasis will still be on harvest of excess good quality pink salmon and on achieving at least minimum pink escapements where applicable. However major concern will be directed toward the run strength of late run sockeye and chum salmon.

Eighth Period: 3-1/2 days (78 hours) - 12:00 Noon August 24 through 6:00 P.M. August 27. This eighth period will be primarily a cleanup period for most pink salmon stocks; all escapement requirements should be mostly assured and all excess pink salmon of acceptable quality should be available for harvest in near terminal areas where applicable. Again, this period will require a major emphasis on multi-species management; it is a critical management period for late run sockeye and chum salmon stocks as well as early run coho salmon stocks.

Chum and Coho Salmon

A large portion of the 1993 Kodiak chum and coho salmon harvest will occur as bycatch in nonterminal locations during fishing periods having fishing time associated with major pink salmon fisheries. System specific chum and coho salmon fisheries which occur during the pink salmon fishery will commonly result in pertinent management units having less fishing time than management units targeting primarily pink salmon stocks. This approach emphasizes the use of more terminally located management units for targeted chum and coho salmon management (i.e. Inner Kukak Section, Zachar Bay Section, Kizhuyak Section, etc.)

EMERGENCY ORDER INSEASON ANNOUNCEMENTS ("GETTING THE WORD")

Fishing period announcements may not always be predictable because the fishery is managed on data evaluation which is compiled daily. Data used to make fishery decisions includes (1) escapements via weir counts and/or aerial surveys, (2) harvest trends (total catch and catch per unit effort) and (3) information on fish buildups.

Once enough information has been collected to determine fishing time needed to harvest surplus fish an emergency order and a fishery announcement is "immediately" issued in the following manner:

- 1) A news release is constructed detailing:
 - a) The date, time, and number of the emergency order announcement.
 - b) The length of the fishing period.
 - c) The opening and closing times and dates of the fishing period.
 - d) The areas open to fishing.
 - e) The areas closed to fishing (those sections not listed as being open).
 - f) The location of "closed water" marker adjustments.
 - g) Justification for the opening/closing
- 2) The news release is posted at the entrance of the Kodiak ADF&G office.
- 3) Copies of the news release are made available at the Kodiak office. For after hours availability, copies are stored at the main entrance.
- 4) The news release is recorded on a 24 hour recorded message phone (Number 486-4559).
- 5) The news release is made available to three local radio stations (K.V.O.K., K.M.X.T., and K.G.T.L.) to be played by these stations at predesignated times during the day.
- 6) The news release is announced over SSB channel 4125 Khz following the marine weather broadcasts. Commonly, the first reading of a news release occurs after the 6:00 P.M. weather, but occasionally the initial reading comes after the 8:00 A.M. weather broadcast.

- 7) The news release is distributed to all processors either by hand, verbally on the telephone, by tele-fax, or through the ADF&G recorded message phone; this information is then passed along to their respective tenders.
- 8) Information on the most current news release or emergency order can also be obtained by calling the Kodiak ADF&G office during working hours, or by calling Dave Prokopowich (486-6007) or Kevin Brennan (486-6475) after working hours or on weekends.
- 9) Copies of emergency orders are mailed to a current listing of required and interested recipients.
- 10) Many fishers, ADF&G vessels and camps, and Fish and Wildlife Protection vessels use a small tape recorder to document the exact wording of each announcement as broadcast. This is a prudent thing to do when considering the complicated nature of each announcement.

NEW REGULATIONS

There are several new regulations for the Kodiak commercial salmon fishery in 1993, as adopted by the Alaska State Board of Fisheries (BOF) at a meeting held in Kodiak during January 1993. Following is a brief synopsis of the new regulations; a complete copy of all the new regulations is currently available at the Fish and Game office. In addition to the regulatory changes listed below, the BOF made some modifications of existing management plans and passed into regulation two additional plans (see section MANAGEMENT PLANS). The new 1993 Commercial Salmon Fishing Regulations book for the Kodiak Area may be available soon.

5AAC 18.200. Description of Districts

Southeast Afognak Section

In past regulations a description of the Southeast Afognak Section was accidentally omitted from the Description of Districts. A legal language was included this year which specifies the boundaries of this section as the latitude of Cape Kostromitinof on the north, and a line from Head Point on Afognak Island to Dolphin Point and the latitude of Dolphin Point on the south.

Spiridon Bay and Central Section

The boundary between these sections was moved slightly to the east to accommodate a traditional gillnet site. The boundary in Spiridon Bay had been the longitude of Hook Point, and has now moved slightly further into the bay, to 153°46'20" W. longitude.

Outer Karluk Section

The southern boundary of this section is the latitude of Pafco Point, however this latitude was incorrectly listed in the regulation book. The correct latitude is 56°36'20" N. latitude.

5AAC 18.201. Seaward Boundary of District (Three Mile Limit)

According to Title 50, part 674 of the Code of Federal Regulations it is unlawful to engage in commercial fishing for salmon in waters seaward of the state (the "three mile limit") territorial sea boundary west of Cape Suckling. During the 1993 Board of Fisheries meeting held in Kodiak, board members passed regulatory language to clarify the prohibition of salmon fishing outside the territorial sea boundary, stating that the seaward boundary of all districts in the Kodiak Area will be the territorial sea boundary as shown on NOAA charts 16580 and 16568.

5AAC 18.320. Fishing Periods

To allow for the orderly harvest of sockeye salmon returning from the Spiridon Lake stocking project a special harvest area has been designated in the normally closed portion of the Spiridon Bay Section. Language was added to this section of the regulations to specify that openings will be by emergency order only, will only occur during daylight hours, and be a maximum of 6 hours in duration. A management plan for this fishery was also approved by the BOF. Due to low numbers of sockeye salmon expected to return to Spiridon this year (4,000), and projected fishing time of 4 1/2 days per week during the pink salmon fishery, no fishing time is expected to be necessary in the special harvest area this year.

5AAC 18.330. Gear

In the last regulation book an oversight in editing lead to some confusion about the type of gear which could operate in the Alitak Bay District after September 4. The wording mistakenly allowed set gillnet gear to fish in the Cape Alitak and Humpy/Deadman Sections. This was corrected to say that after September 4, salmon may be taken by seine gear in the entire Alitak Bay District.

5AAC 18.331. Gillnet Specifications and Operation

Set Gillnet Attachment

A regulation which would have modified the attachment point of set gillnets in the Moser-Olga Bay Section was passed by the BOF, but the Department of Law subsequently disapproved the regulation for filing. The attachment for gillnets in the Kodiak Area will remain as has been listed in 5AAC 18.331.

5AAC 18.332. Seine Specifications and Operation

Beach Seine Operation

Language which clarifies the manner in which a beach seine is operated in the Kodiak Area was passed into regulation by the BOF. A beach seine must be set from, and hauled back to, a beach,

or to a vessel anchored to a beach. For beach seines only the shoreward end of the seine or lead may be anchored, and an additional anchor may be used to attached the vessel to a beach only while retrieving the beach seine. Also it is defined that any ring, strap, purse or tow line may only be attached to the corkline of beach seines. As always, one end of the beach seine must remain on the beach above the surface of the water at all times during the set, and a beach seine has ceased fishing only when all the leadline is out of the water.

Seine Leads

Minimum mesh size is seven (7) inches. Language was passed which states that it is illegal to use overlapping panels of web in a seine lead.

5AAC 18.337. Purse Seine Practice Sets

The BOF has legalized the practice of purse seine practice sets. However to minimize potential enforcement problems the time period for making practice sets was limited to June 1 through June 7, during daylight hours only. Similarly, the locations where practice sets can be made is limited to four (4) areas: inside Lazy Bay, inside Larsen Bay, within 1/2 mile of the Sealand dock in the city of Kodiak, and within 1/2 mile of the entrance to the boat harbor in the city of Old Harbor.

5AAC 18.350 Closed Waters

Dry Bay

In order to provide additional protection for local stocks the closed water sanctuary in Dry Bay has been changed to all water west of 155°44' W. long. This was implemented by emergency order during the past two seasons.

Karluk Closed Water Sanctuary

Due to the problems encountered in the past with the closed water sanctuary seaward of Karluk Lagoon, as currently described in regulation 5AAC 18.350., the following closed water sanctuary will be in effect, by emergency order, near the entrance to Karluk Lagoon, stream #255-101 (Figure 2):

5AAC 18.350 CLOSED WATERS (2) Southwest Kodiak District

(E) That portion of the Southwest Kodiak District (off of the entrance to Karluk Lagoon (stream #255-101)) enclosed by a line from 57°34'28" N. lat., 154°28'18" W. long. to 57°34'32" N. lat., 154°26'42" W. long. (NOAA Chart #16598).

Buskin River Closed Water Sanctuary

The stream mouth of the Buskin River (stream #259-211) has moved considerably over the past several years. The markers which were present were not providing adequate protection to salmon migrating into the stream. The north shore marker has been moved and an offshore point is

designated to aid in triangulation of the closed water area. The offshore point is at the reef directly east of the spit, and may be marked with a buoy. The location of the closed water will be described in the first salmon emergency order as follows (Figure 3):

5AAC 18.350 CLOSED WATERS (6) Northeast Kodiak District

- (E) Buskin River: all waters inside of a line running from a marker on the bluff north of the mouth of the Buskin River at approximately 57°45'48" N. lat., 152°28'23" W. long. to a point offshore at 57°45'21" N. lat., 152°28'09" W. long. to a marker located onshore south of the river mouth at approximately 57°45'09" N. lat., 152°28'39" W. long. (NOAA Chart #16595)

5AAC 18.355. Reporting Requirements

Beginning in 1993 commercial fishers must report on an ADF&G Fish Ticket salmon kept for personal use. New fish tickets will have a specific area for reporting salmon kept for personal use, but if an old style ticket is used the number of salmon, by species, taken for personal use must be recorded on the ticket.

MISCELLANEOUS REGULATORY CLARIFICATIONS

Closed Water Adjustments

As a result of conflicting interpretations of Alaska Statute 16.05.785, failure to remove markers, there will be no inseason adjustments of closed waters unless ADF&G personnel will be able to remove old markers and install new markers or unless inseason adjustments of closed waters are made to a specific stream terminus. All adjustments to closed waters listed in 5AAC 18.350 will be made by emergency order.

Closed Water Sanctuaries

In areas where ADF&G has deployed regulatory markers to establish waters closed to fishing, a straight line closure is in effect provided that no portion of that line is less than 500 yards from the seaward extremities of the exposed tideland banks which designates the stream mouth. Consequently, common closed water configurations will be areas of various shapes, depending upon the nature of each individual stream mouth extending between the two regulatory markers. In areas where ADF&G has deployed regulatory markers to establish waters closed to fishing in bays a straight line closure is in effect.

In the Mainland District, ADF&G is expanding its stream marker program. Fishers participating in salmon fisheries located in the Mainland District should be aware that closed water sanctuaries may be larger in some areas due to the placement of markers, to protect "buildup" fish during low tides.

Boundary Determinations

When determining the location of a particular district or section boundary, or any inseason emergency order boundary, the latitude and longitude as plotted on a NOAA navigational chart, NAD 1927, approximate scale 1:80,000, will represent the correct boundary locations. Boundaries plotted on NOAA navigational charts using NAD 1983 may not correspond to the correct locations. Latitude and longitude as determined by Loran or Global Positioning System (GPS) bearings may represent incorrect boundary locations. District and Section boundaries are depicted on the current Kodiak salmon statistical area chart (available at Kodiak ADF&G office).

Section Boundaries

The Raspberry Straits Section is not part of the Southwest Afognak Section.

Purse Seine Leads

Minimum mesh size is seven (7) inches. Double panels of web overlapped in the lead will not be legal.

Set Gillnets - Operation of Gear

Leads

"Seine webbing" used as a lead for set gillnets is not intended to "gill salmon". Set gillnet leads which have similar mesh size and web construction to the actual set gillnet gear will not be considered legal gear.

Operation of Set Gillnets

Set gillnets must be operated in substantially a straight line, except that no more than 25 fathoms of a set gillnet may be used as a hook. A hook may be used in any configuration. When a set gillnet is being operated primarily as a "hook in any configuration" it will be considered illegal to actively operate that gillnet as a purse or beach seine (such as "round hauling").

FISH TICKETS

A reminder to all fishers to check the statistical area recorded on each of your fish tickets. It is required that the correct harvest location(s) be shown on each ticket and it is the responsibility of each fisher to ensure tender operators or the cannery personnel record the correct harvest location on each ticket. This information is extremely useful in evaluating inseason harvest levels, stock contribution, and effort distribution.

Seiners

Please provide estimates of harvest by area to tender operators. For example "1/3 of my reds were from Cape Alitak (257-20) and the rest were from Red River (256-20). The rest of my fish were 1/2 and 1/2 from each of these areas". Prior to signing your tickets, check to make sure the proper harvest information by **STATISTICAL AREA** has been entered.

Of particular importance will be the accurate recording of the harvest from that portion of the Shelikof Strait regulated by the Shelikof Strait sockeye salmon management plan. In order to provide an accurate accounting of sockeye salmon harvests in this area, ADF&G and Fish and Wildlife Protection will conduct extra monitoring of harvest activity and tendering operations in this area during the July 6 to July 25 time period of this plan.

Gillnetters

Because of the fixed nature of this gear, each permit holder's reporting area (statistical area) should be consistent between landings. However, in the event that you become "exploratory" with your nets and move into a new statistical area, please provide the tender operator with that information. Prior to signing your tickets, ensure that the proper harvest information by **STATISTICAL AREA** has been entered.

MANAGEMENT PLANS

Currently there are seven (7) Board of Fisheries approved management plans which provide guidance to ADF&G for specific portions of the Kodiak Management Area. Each management plan affects several management units (Table 4) through part or all of the salmon fishing season. As with any good plan, the test of time and a continued review process will determine its effectiveness at accomplishing the desired biological and allocative goals. The 1993 season will provide additional opportunities to evaluate the merits of these Board approved plans. One of these, the Westside Kodiak Management Plan, covers the greatest geographical area and affects more user groups and gear types than any other plan. In contrast, the Crescent Lake Plan is associated with a relatively small coho enhancement project which impacts the subsistence fishery in the vicinity of Port Lions, and so a plan was needed to clarify coho fishery priorities for that area.

Proper implementation of these plans in 1993 will require a major communication effort between ADF&G and the industry. As with any of these plans, if there is a need for plan clarification, all inquiries, suggestions, and concerns are encouraged to be directed to ADF&G, Kodiak. A discussion of each plan follows.

Cape Igvak

The Cape Igvak Management Plan covers the time period from June 5 through July 25 for fishing activity in the Cape Igvak Section of the Mainland District (Table 5). This plan has been in effect since 1978 and allocates a percentage of the available Chignik sockeye salmon for harvesting (approximately 15%) to Kodiak permit holders when specific biological and harvest criteria are met in Chignik. Fishing time after July 25 in the Cape Igvak Section will be targeted toward pink, chum and coho salmon bound to spawning streams in the Cape Igvak Section and in the Wide Bay Section.

The 1993 forecast for Chignik sockeye salmon runs indicate that early production should be above average, and that late production should continue at or above average.

A detailed description of the Cape Igvak Management plan is listed in the regulation book under 5AAC 18.360.

Alitak Bay District

This plan covers the entire commercial salmon fishing season, and identifies the primary management species by management unit throughout the season (Table 6). The plan affects the sockeye salmon stocks returning to the Frazer, Upper Station, and Akalura systems, and the pink and coho salmon stocks returning to Dog Salmon, Upper Station, Akalura, Humpy Cove, Deadman, Horse Marine, and Silver Salmon systems. This plan has been in effect since 1988.

The management chronology for Olga Bay stocks identifies the targeted management stocks by approximate time period. In situations where two or more targeted stocks overlap in run timing a "blended" management approach will occur, whereby adequate fishing time will be provided to ensure desired escapement goals are not exceeded for the more dominant stock(s) yet that the minimum escapement goals for the less dominant stock(s) are achieved. As decreed by the Board of Fisheries, fishing time directed on these stocks will occur simultaneously in the traditional management units for harvesting these stocks, namely the Cape Alitak Section and the Moser-Olga Bay Section. Management for these stocks will emphasize an aggressive strategy to contain the harvest to these traditional harvest units; this strategy also applies to the remainder of the stocks in the Alitak Bay District.

The regulatory wording for implementing this management plan appears in the 1993 Commercial Finfish Regulation Book under 5AAC 18.361. Dates listed in the plan are approximate and may vary with changes in run timing; an exception is the June 9 commercial test fishery, which is a firm date. The specifics for managing the 1993 returns need to consider the expected magnitude of the targeted stocks returning to the Olga Bay systems. The sockeye salmon returns to Alitak are expected to yield relatively strong sockeye salmon production from the early run Frazer system and the late run Upper Station system. In conjunction with the late run sockeye production, a relatively strong return of pink salmon to the Dog Salmon river is expected to be available to the fishery. Because of the early timing of Dog Salmon River pink return harvestable surplus for both stocks should be taken in the traditional Cape Alitak, and Moser/Olga Bay

Sections. Fishing time in the upper Olga Bay sections is not expected in 1993 unless the Upper Station return is much weaker than forecasted.

Some specific points to stress this year are:

- The approximate June 12 through June 24 period is identified as an aggressive management time for Frazer sockeye salmon.
- To maintain equitable and orderly harvest opportunities for all gear types, and to insure that escapement requirements are achieved for the 1993 season, the minimum escapement goal for Frazer sockeye salmon (140,000) will be targeted.
- The minimum pink salmon escapement requirement for the Dog Salmon system is 60,000 fish and the desired goal is 180,000 pink salmon.
- In the event that fishing time is required in Upper Olga Bay management units, minimum advance notice will be as identified.
- Sockeye returning to Akalura will be aggressively managed in the Inner Akalura Section, to insure the sockeye escapement does not exceed 60,000 fish.

Westside Kodiak

The Board of Fisheries, at their December 1989 meeting in Kodiak, adopted into regulation this management plan which identifies the management chronology for major Westside Kodiak salmon stocks (Table 7).

The goal of this Management Plan is to achieve escapement and harvest objectives of sockeye salmon returning to the Karluk, Ayakulik, and other Westside minor systems, and of pink, chum, and coho salmon returning to systems in the Southwest Afognak, Central, North Cape, Anton Larsen Bay, Sheratin Bay, Kizhuyak Bay, Terror Bay, Inner Uganik Bay, Spiridon Bay, Zachar Bay, Uyak Bay, Outer Karluk, Inner Karluk, Sturgeon Bay, Halibut Bay, Outer Ayakulik and Inner Ayakulik Sections. The intent of the Board is to insure that salmon bound to these systems be harvested to the extent possible by the traditional fisheries located in all 17 sections. The plan directs the department to manage the Northwest Kodiak and the Southwest Kodiak Districts and the Southwest Afognak Section in accordance with the guidelines set out in this plan.

This plan was submitted as a proposed regulation to the Board of Fisheries by the Kodiak Management Staff in order to allow industry the opportunity to comment on existing harvest strategies and to clarify their intent. Frequently, Kodiak fishers had expressed concerns over how the department will manage the Westside management units (sections) into the 1990's, when local sockeye stocks are projected to be near maximum production, since this will affect the traditional harvest opportunities between fixed and mobile gear. The annual harvest strategy has traditionally invoked a "blend" of fishing time between the 17 management units covered by this plan. At times this "blend" has not been totally understood by industry and has resulted in enough allocative uneasiness that future management stability could be jeopardized. Guidelines for this "blend" needed to occur in regulatory form to specifically identify inseason harvest strategy and

to dispel any concern and confusion. Again, the previous regulatory structure did not provide the information needed by industry to evaluate inseason management decisions which affect allocation concerns of the three gear types affected by this plan.

This management plan reflects the realization of long term management goals and identifies current management practices both of which were initially implemented in 1971. The basis for these goals and practices was primarily to rebuild depleted Karluk and depressed Ayakulik sockeye salmon stocks. This plan provides a predictable management framework for these rebuilt stocks, as well as major pink, chum and coho salmon stocks of westside Kodiak, and helps to stabilize fishing opportunities between the three gear types on the highest quality fish in these districts and sections.

The regulatory wording of this plan appears in the 1993 Commercial Finfish Regulation Book under 5AAC 18.362.

North Shelikof Strait Sockeye Salmon

The Board of Fisheries in December 1989 created this management plan in response to concern that the fishing patterns and quantities of sockeye harvested by Area K seiners in 1988 represented the onset of an expansion of the interception of Cook Inlet bound sockeye in Kodiak Area waters. This plan was meant to contain this interception to not exceed estimated historical interception levels yet still provide for traditional opportunities to harvest high quality pink and chum salmon from local stocks. **The major impact of this plan was to create "sockeye harvest caps" for that portion of the North Shelikof which encompasses eight (8) management units. After these sockeye harvest caps are met, commercial salmon fishing is restricted in these 8 management units to waters inside of a line drawn cape to cape.**

During the January 1993 Board of Fisheries meeting in Kodiak, a modification of the management plan was made to allow the traditional near shore seine fisheries of the Southwest Afognak Section to continue, in the event of the sockeye harvest cap being exceeded. A 1/2 mile corridor along the capes was removed from the earlier definition of the "seaward zone" of the Southwest Afognak Section. After the harvest cap is met fishing will be restricted in waters outside of the 1/2 mile corridor (Figure 4).

The regulatory wording for this management plan is listed below and under 5AAC 18.363.

From July 6 through July 25 in the Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay, and Big River Sections of the Mainland District, and in the Shuyak Island and Northwest Afognak Sections of the Afognak District, the department shall manage the fishery as follows:

- Management of the fishery must be based on local stocks;**
- the fishery may remain open during normal fishing periods until the harvest exceeds 15,000 sockeye salmon;**

- when the harvest exceeds 15,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the shoreward zones, as described below:
- Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay. and Big River Sections west of a line from Cape Douglas at 58°51'06" N. lat, 153°14'54" W. long, to a point at 58°42'40" N. lat, 153°26'18" W. long, to a point east of Swikshak River at 58°38'06" N. lat., 153°35'24" W. long., to Cape Chiniak at 58°31' N. lat., 153°54'21" W. long., to Cape Nukshak at 58°23'30" N. lat., 153°57' W. long., to Cape Ugyak at 58°16'36" N. lat., 154°06'03" W. long., to Cape Gull at 58°13' N. lat, 154°08'30" W. long., to Cape Kuliak at 58°08'11" N. lat., 154°12'34" W. long., to Cape Atushagvik at 58°05' N. lat., 154°18'48" W. long., to Cape Iktugitak at 58°01'12" N. lat., 154°34'48" W. long to the southern entrance of Dakavak Bay at 58°01' N. lat., 154°43'30" W. long.
- Shuyak Island and Northwest Afognak Sections south and east of a line from Point Banks at 58°38' N. lat., 152°18'54" W. long., to Dark Island at 58°38'45" N. lat., 152°33'05" W. long., to Gull Island at 58°35'48" N. lat., 152°38'45" W. long., to the northern entrance of Big Bay at 58°34'06" N. lat., 152°40'12" W. long., to the western entrance of Blue Fox Bay at 58°27'41" N. lat., 152°43'42" W. long., to Black Cape at 58°24'33" N. lat., 152°53'09" W. long., to Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long.

From July 6 through July 25 in the Southwest Afognak Section of the Afognak District, the department shall manage the fishery as follows:

- management of the fishery must be based on local stocks;
- the fishery may remain open during normal fishing periods until the harvest exceeds 50,000 sockeye salmon;
- when the harvest exceeds 50,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the Southwest Afognak Section Shoreward Zones east of a line from one-half nautical mile west of Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long., to one-half nautical mile west of Tanaak Cape at 58°15'36" N. lat., 153°06'09" W. long., to one-half nautical mile west of Steep Cape at 58°12'05" N. lat., 153°12'33" W. long., to one-half nautical mile west of a point at 5 at 58°08'25" N. lat., 153°18'52" W. long., to one-half nautical mile west of Raspberry Cape at 58°03'35" N. lat., 153°25'06" W., long.

All fishers and tender operators should familiarize themselves with the boundaries of these "seaward" and "shoreward" zones in each of these eight management units. Also, it will be the responsibility of both the permit holder and the tender operator to insure that fish tickets for fish harvested in the geographical area covered by this plan properly reflect the poundage and quantities of salmon by species taken in this geographical area. If there are lingering questions on this management plan feel free to contact ADF&G Kodiak staff.

Crescent Lake

As indicated earlier, this management plan is associated with a relatively small coho enhancement project which could impact the subsistence fishery in the vicinity of Port Lions. This plan clarifies the harvest priorities for coho salmon returning to the Settler Cove area near Port Lions. This plan was slightly modified by the Board of Fisheries, during the January 1993 meeting in Kodiak. Previously the plan allowed commercial harvest inside the breakwater at Port Lions only after September 16; this has now changed to September 10. In addition, the time period that this plan is in effect was changed from the entire salmon season to the time period July 15 through October 31. The wording of the regulations guiding this plan are listed below as well as in the 1993 Commercial Finfish Regulation Book under 5AAC 18.364.

5AAC 18.364. Crescent Lake Coho Salmon Management Plan.

- (a) From July 15 through October 31, the Department shall manage the commercial, sport, and subsistence fisheries in Settler Cove to provide for full utilization of the enhanced stock of coho salmon returning to Crescent Lake in accordance with the Crescent Lake Coho Salmon Management Plan in this section.
- (b) Sport and subsistence fisheries are allowed in all waters of Settler Cove consistent with 5AAC 64 and 5AAC 01.
- (c) The department may open, by emergency order, those waters of Settler Cove between the causeway and a line from the seaward end of the Port Lions breakwater to a department marker located directly across Settler Cove from the breakwater, to the commercial taking of salmon only as follows:
 - (1) the department may not allow the commercial taking of salmon before September 10; and
 - (2) before opening the fishery, the department shall determine that 500 or more coho salmon are available in Settler Cove for harvest.

Eastside Afognak

For the past several years the commercial salmon fisheries of the eastside of Afognak Island have been managed under an informal management plan formulated by Kodiak Area management biologists and Kitoi Bay hatchery managers. The Board of Fisheries, during the January 1993 meeting in Kodiak, adopted this plan into regulation. The goal of this plan is to achieve broodstock requirements for the hatchery and escapement requirements for local stocks, and specify the requirements for fishing time in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections (Table 8). The wording of the regulations guiding this plan are listed below as well as in the 1993 Commercial Finfish Regulation Book.

5AAC 18.365. Eastside Afognak Management Plan.

- (a) The goal of the Eastside Afognak Management Plan is to achieve escapement and harvest objectives of sockeye, pink, coho, and chum salmon returning to natural spawning systems in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections, and broodstock to Kitoi Bay hatchery. It is the intent of the board that salmon bound for these systems be harvested by the commercial fisheries located in these sections.
- (b) The Southeast Afognak Section shall be managed on sockeye salmon returning to Afognak Lake during the period from June 9 through July 5. From July 6 through August 24, fishing opportunities will be based on pink salmon returning to major systems in Afognak, Kazakof (Danger), and Marka Bays. After August 24, fishing time will be dependent on coho salmon returning to this section.
- (c) The Duck Bay Section shall be managed on early chum or sockeye salmon returns to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 24, fishing time will be based on returning mixed wild and hatchery pink salmon. After August 24, this section shall be managed on local coho salmon runs.
- (d) The Izhut Bay Section shall be managed on the early chum or sockeye salmon returning to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 1, this section may remain closed to fishing to assure that pink salmon cost recovery goals are achieved at Kitoi Bay hatchery. If hatchery cost recovery harvests are not required, fishing time in this section will depend on returning wild and hatchery pink salmon from July 19 through August 24. After August 24, fishing time will be dependent on returns of local coho salmon and late hatchery sockeye salmon runs.
- (e) The Kitoi Bay Section shall be managed on early run chum or sockeye salmon returning to the Kitoi Bay hatchery, from June 9 through July 20. From July 3 through July 3 through July 20, fishing opportunities will not occur until chum salmon broodstock requirements for the hatchery are assured. After July 20 through August 20, this section will be managed for pink salmon cost recovery and broodstock requirements. If there is no pink salmon cost recovery, the section may be managed to harvest pink salmon that exceed broodstock needs. After August 20, fishing opportunities may be provided to harvest returning late sockeye and coho that exceed broodstock needs.

Spiridon Bay Sockeye Salmon

The Kodiak Regional Aquaculture Association, in conjunction with ADF&G, has developed a supplemental run of sockeye salmon in Spiridon Bay. Sockeye smolt are stocked in Spiridon Lake to rear and then released into Spiridon Bay. Because of the steep topography of the creek leading to the lake the returning sockeye can not ascend to naturally spawn. All returning sockeye are intended for common property fisheries. ADF&G, KRAA, and the U.S. Fish and Wildlife Service developed a management plan which attempts to fully utilize these salmon while protecting local stocks. This management plan was adopted into regulation by the Board of Fisheries at the January 1993 meeting in Kodiak. The plan identifies a Special Harvest Area

inside the normally closed waters area of the Spiridon Bay Section (Figure 5). Openings shall be of short duration, no more than 6 hours, during daylight hours only, and will begin with a flare launched by ADF&G. The only legal gear type is seine. The harvest area may be adjusted or the harvest foregone entirely if local natural stocks are in jeopardy. The regulatory wording of the plan follows, and is listed in the 1993 Commercial Finfish Regulation Book.

5AAC 18.366. Spiridon Lake Sockeye Salmon Management Plan.

(a) The department shall manage the commercial, sport, and subsistence fisheries in Spiridon Bay to provide for full use of the enhanced stock of sockeye salmon returning to Spiridon Lake.

(b) The purpose of the Spiridon Bay harvest strategy is to allow for the orderly harvest of sockeye salmon returning to Telrod Cove from the Spiridon Lake enhancement project while providing adequate protection for local natural salmon stocks returning to other streams of the bay. The intent of the enhancement project is for the harvest of returning enhanced salmon to occur in traditional commercial fishing areas of the Northwest Kodiak District during openings directed at harvesting Karluk sockeye and westside pink and chum salmon stocks.

(c) The Spiridon Bay Special Harvest Area is that area in Spiridon Bay west of a line from 153°37'21" W. long., 57°38'54" N. lat., to the opposite shore at 153°38'27" W. long., 57°38' N. lat., and east of 153°42'24" W. long.

(d) Only purse seine and beach seines may be operated in the Spiridon Bay Special Harvest Area.

(c) If a harvestable surplus of enhanced sockeye salmon is in the special harvest area, emergency order openings, not to exceed six hours per day and only during daylight hours, will be announced. The openings will be started by an aerial flare launched by an ADF&G representative. When possible, openings will be coordinated to occur at the beginning of openings in the Northwest Kodiak District.

SOCKEYE SALMON ESCAPEMENTS GOALS FOR AREA K MAJOR SOCKEYE SALMON SYSTEMS

For targeted sockeye salmon fisheries on systems having fish weirs the total enumeration of upstream migrants can be used to determine the amount of fishing time required to harvest surplus fish. This commonly occurs for the Karluk, Ayakulik, Upper Station, and Frazer systems (major systems) and for the Akalura, Saltery, Buskin, Litnik, Pauls, and Thorsheim systems (minor systems). For sockeye salmon systems without weirs, fishing time is generally conservative and occurs at the discretion of ADF&G, in proportion to the perceived system specific return strength.

Minimum and desired escapement requirements have been identified for each river's sockeye salmon stocks (Table 9). A basic management function is to achieve minimum escapements for

stocks exploited by targeted fisheries, even if it means that directed fishing time on those stocks does not occur. When the possibility exists that desired escapements may be exceeded, significant deviations from optimum production could occur because of that excess. Maximum directed fishing time on these stocks would be allowed, even if it requires continuous stream terminus fishing to contain the escapement at or near desired levels. These are the extreme scenarios occasionally needed for Kodiak Area sockeye salmon management. More commonly only a moderate amount of directed fishing time is required to harvest sockeye salmon surpluses and to provide escapement which approaches desired levels.

As with the preseason harvest projections, a good tool for illustrating escapements are escapement graphs by stream (Appendix B.1. - B.6.). These are curves drawn based on historical average cumulative escapement by day, scaled to the minimum and desired escapement goal for each particular system. Actual escapements can be plotted on these graphs to compare with the projected cumulative count. Since fishing time is strongly tied to escapement levels, these graphs can be valuable aids in understanding current ADF&G management actions, and in planning for future fisheries. Actual inseason escapement counts can be heard daily at 8:10 A.M. on SSB channel 3230 Khz.

Table 1. Commercial salmon harvest in 1992 and harvest projections for the Kodiak Management Area, 1993.

	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1992 Projected Harvest	10,000	3,247,000	250,000	9,220,000	870,000	13,597,000
1992 Actual Harvest	24,300	4,167,700	280,100	3,310,500	679,500	8,462,100
1993 Projected Harvest	21,000	2,208,000	290,000	21,575,000	1,200,500	25,294,500

FISHERY	1992 HARVEST ^a		1993 HARVEST ^{a,b}
	Projection	Actual ^c	Projection as of 3/30/93
Early Run Sockeye Salmon Fisheries (6/9-7/15)			
Cape Igvak	262,500	161,700	230,000
Karluk	150,000	602,100	350,000
Ayakulik	250,000	957,500	138,000
Frazer	704,000	245,000	232,000
Upper Station	50,000	22,800	35,000
Minor Systems	75,000	16,700	50,000
Other	70,000	470,400	70,000
SubTotal	1,561,500	2,476,200	1,105,000
Late Run Sockeye Salmon Fisheries (7/16-9/15)			
Afognak (Hatchery)	12,000	5,000	18,000
Cape Igvak	97,500	31,300	95,000
Karluk	1,000,000	605,800	325,000
Ayakulik	170,000	141,300	92,000
Frazer	176,000	29,800	58,000
Upper Station	125,000	219,400	410,000
Minor Systems	75,000	15,100	75,000
Other	30,000	643,800	30,000
SubTotal	1,685,500	1,691,500	1,103,000
TOTAL SOCKEYE	3,247,000	4,167,700	2,208,000
Coho Salmon Fisheries (8/1-10/1)			
Afognak (Hatchery)	0	5,000	5,000
Afognak (Natural)	20,000	42,700	35,000
Westside	145,000	100,400	135,000
Alitak	20,000	24,500	25,000
Eastside/Northend Kodiak	25,000	75,600	50,000
Mainland	40,000	31,900	40,000
SubTotal	250,000	280,100	290,000
Pink Salmon Fisheries (7/6-9/5)			
Afognak (Hatchery)	2,320,000	845,400	6,500,000
Afognak (Natural)	700,000	255,700	850,000
Westside Kodiak	4,600,000	1,306,100	4,750,000
Alitak	200,000	59,300	2,870,000
Eastside/Northend Kodiak	600,000	645,400	5,750,000
Mainland	800,000	189,600	855,000
SubTotal	9,220,000	3,310,500	21,575,000

-Continued-

Table 1. (page 2 of 2)

FISHERY	1992 HARVEST ^a		1993 HARVEST ^{a,b}
	Projection	Actual ^c	Projection as of 3/30/93
Chum Salmon Fisheries (6/6-9/5)			
Afognak (Hatchery)	25,000	3,500	500
Afognak (Natural)	30,000	40,200	60,000
Westside Kodiak	300,000	270,700	390,000
Alitak	60,000	34,600	70,000
Eastside/Northend Kodiak	180,000	216,400	275,000
Mainland	275,000	114,100	405,000
SubTotal	870,000	679,500	1,200,500
GRAND TOTAL	13,597,000 ^d	8,462,100 ^e	25,294,500 ^f

^a Numbers of fish.

^b 1993 harvest projections.

^c Actual harvest estimates by fishery as of 11/20/92. Sockeye harvest estimates by fishery has changed as further stock composition work was completed (3/30/93).

^d Includes 10,000 chinook - projected harvest.

^e Includes 24,300 chinook - actual harvest.

^f Includes 21,000 chinook - projected harvest.

Table 2. Expected harvest from supplemental salmon production, by system and species for the Kodiak Management Area, 1993.

System	Sockeye	Pink	Coho	Chum
Kitot Bay Hatchery Complex ^a	18,000 ^b	6,500,000	5,700	5,000
Spiridon Lake ^c	4,000	0	0	0
Hidden Lake	0	0	2,000	0
Waterfall Lake	0	0	0	0
Malina Lake	0	0	0	0
Crescent Lake ^d	0	0	3,500	0

^a See Eastside Afognak Salmon Management Plan.

^b Harvest is expected to occur during fisheries targeting pink salmon.

^c See Spiridon Lake Sockeye Salmon Management Plan. Based on projected 1993 returns, fishing time is not expected to occur in the Spiridon Bay Special Harvest Area.

^d See Crescent Lake Salmon Management Plan.

Table 3. Commercial salmon season opening times and dates by species for the Kodiak Area, 1993.

FISHERY	EARLIEST OPENING TIME/DATE	
	Firm Time/Date	Approximate Time/Date
Early Run Sockeye Salmon Fisheries		
Cape Igvak Section ^a	-	12:01 A.M. June 5-9
N.W. Kodiak District ^b	12:00 Noon June 9	
Inner Ayakulik and Outer Ayakulik Sections ^c	-	Low tide June 7-9
Alitak District ^b	12:00 Noon June 9	
Minor Systems ^d		
Uganik	-	12:00 Noon June 14
Paramanof	-	12:00 Noon June 14
Pauls/Perenosa	-	12:00 Noon June 14
Litnik	-	12:00 Noon June 9-14
Saltery	-	12:00 Noon June 14
Kafliia/Swikshak	-	12:00 Noon June 14
Pink/Chum Salmon Fisheries ^e		
Mainland District	12:00 Noon July 6	-
Afognak District	12:00 Noon July 6	-
N.W. Kodiak District	12:00 Noon July 6	-
S.W. Kodiak District	12:00 Noon July 6	-
Alitak District	12:00 Noon July 6	-
Eastside Kodiak District	12:00 Noon July 6	-
N.E. Kodiak District	12:00 Noon July 6	-
Late Run Sockeye Salmon Fishery		
Cape Igvak Section ^f	-	12:01 A.M. July (?)
All remaining late run sockeye fisheries ^g	-	12:00 Noon July 15
System Specific Coho Salmon Fisheries ^h		
Mainland District	-	12:00 Noon Sept. 1
Afognak District	-	12:00 Noon Aug. 15
N.W. Kodiak District	-	12:00 Noon Sept. 1
S.W. Kodiak District	-	12:00 Noon Sept. 1
Alitak District	-	12:00 Noon Sept. 1
Eastside Kodiak District	-	12:00 Noon Sept. 5
N.E. Kodiak District	-	12:00 Noon Sept. 5

-Continued-

Table 3. (page 2 of 2)

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- ^a Actual opening date will be determined by sockeye escapement levels into the Chignik River system. Fishing time will be in 24 hour increments.
 - ^b Actual opening time/date is as shown. This opening is considered a commercial test fishery; fishing time for this initial period will be 33 hours (12:00 noon 6/9 through 9:00 P.M. 6/10).
 - ^c Actual opening date will be determined by the sockeye escapement level into Ayakulik River and opening time by low tide timing during daylight hours.
 - ^d Actual opening time will be determined by sockeye escapement levels into minor systems. Fishing time for this period will be 33 hours (12:00 noon through 9:00 P.M.)
 - ^e Actual opening time/date is as shown. Fishing time for this initial period will be 105 hours (12:00 noon 7/6 through 9:00 P.M. 7/10). See section on Fishing Periods for additional information.
 - ^f Actual opening date will be determined by sockeye escapement levels into the Chignik River System. Fishing time will be in 24 hour increments.
 - ^g Actual opening date for system specific fishing time will be determined by sockeye escapement levels into major systems. All fishing periods will begin at 12:00 noon and end at 9:00 P.M. prior to 8/16 and end at 6:00 P.M. from 8/16 to season's end.
 - ^h Actual opening date for system specific fishing time will be determined by overall coho run strength evaluation and by escapement levels into major systems and minor systems with reliable escapement data.

Table 4. Board of Fisheries approved fishery management plans for the Kodiak Management Area, 1993.

MANAGEMENT PLAN	YEAR INITIATED	MGMT. UNITS AFFECTED	DATES IN EFFECT
Cape Igvak Salmon Management Plan	1978	Cape Igvak Section Wide Bay Section	6/5 - 7/25
Alitak Bay District Salmon Management Plan	1987	Alitak Bay District	6/9 - 10/1
Westside Kodiak Management Plan	1990	N.W. Kodiak District S.W. Kodiak District S.W. Afognak Section	6/9 - 10/1
Crescent Lake Coho Salmon Management Plan	1990	Portion of the Central Section in Vicinity of Port Lions	8/1 - 9/15
North Shelikof Strait Sockeye Salmon Management Plan	1990	S.W. Afognak Section N.W. Afognak Section Shuyak Section Big River Section Hollo Bay Section Inner and Outer Kukak Sect. Dakavak Section	7/6 - 7/25
Eastside Afognak Management Plan	1993	Kitoi Bay Section Izhut Bay Section Duck Bay Section	6/9 - 10/1
Spiridon Bay Sockeye Salmon Management Plan	1993	Special Harvest Area in Spiridon Bay Section	6/9 - 10/1

Table 5. Biological and allocative criteria, and the management chronology, of the Cape Igvak Management Plan for the Kodiak Management Area, 1993.

**BIOLOGICAL AND ALLOCATIVE CRITERIA FOR MANAGING THE CAPE IGVAK FISHERY ON
CHIGNIK BOUND SOCKEYE**

BIOLOGICAL REQUIREMENTS			ALLOCATIVE REQUIREMENTS		
REGULATION 5AAC 18.360	ESCAPEMENT NEEDS		REGULATION 5AAC 18.360	CHIGNIK MINIMUM HARVEST	IGVAK %
	CHIGNIK (EARLY RUN)	CHIGNIK (LATE RUN)			
(a) (b) (c)	THROUGH 6/30 350,000-400,000	-	(a)	EXPECTATIONS OF LESS THAN 600,000	CLOSED
-	-	-	(b)	EXPECTATIONS OF 600,000 ARE IN DOUBT	CLOSED
(a) (b) (c)	-	THROUGH 7/30 195,000-200,000	(c)	EXPECTATIONS OF 600,000 OCCUR	OPEN TO ACHEIVE 15%
-	-	-	(d)	CHIGNIK SALMON % INTERCEPTION CALCULATIONS	80% OF CATCH AT IGVAK ARE CHIGNIK SOCKEYE
-	-	-	(e)	ALLOCATION PERIOD 600,000	6/5 - 7/25 % NOT APPLICABLE
(f)	FROM JUNE 26 - JULY 9 CAPE IGVAK SECTION CLOSED OR SEVERLY LIMITED UNTIL CHIGNIK LAKE RUN EVALUATED		-	-	-
-	-	-	(g)	-	ONE DAY ADVANCE NOTICE
	400,000	250,000		600,000 MINIMUM	15 %

MANAGEMENT CHRONOLOGY FOR CHIGNIK BOUND SOCKEYE AND KODIAK SALMON

CLOSED		CLOSED OR SEVERLY LIMITED		KODIAK BOUND STOCKS AND/OR CHIGNIK LATE RUN STOCKS	
CHIGNIK SOCKEYE STOCKS (EARLY RUN)		CHIGNIK SOCKEYE STOCKS (LATE RUN)			
6/1	6/5	6/26	7/9	7/25	9/5

[illegible]

	JUNE						JULY						AUGUST						SEPTEMBER					
	5	10	15	20	25	5	10	15	20	25	5	10	15	20	25	5	10	15	20	25				
FRAZER SOCKEYE				X	X																			
UPPER STATION SOCKEYE			X	X	X																			
AKALURA SOCKEYE				X	X																			
DOG SALMON PINKS (ODD)								X	X	X														
UPPER STATION SOCKEYE												X	X	X	X									
AKALURA SOCKEYE												X	X	X	X									
DOG SALMON PINKS (EVEN)													X	X	X									
UPPER STATION COHO																	X	X	X					
AKALURA COHO																	X	X	X					
DOG SALMON COHO																	X	X	X					
HORSE MARINE COHO																	X	X	X					
SILVER SALMON COHO																	X	X	X					

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Table 7. Primary management species and fishery chronology of the Westside Kodiak Management Plan for the Kodiak Management Area, 1993.

		6/1	6/9	6/16	6/23	7/6	7/16	8/1	8/16	8/25	9/6	10/31
AFOG. DIST.	S.W.AFOGNAK	CLOSED			E.R.KARLUK SOCKEYE	LOCAL AND MIXED PINK			L.R.KARLUK SOCKEYE/ LOCAL & MIXED PINK	L.R.KARLUK SOCKEYE	LOCAL COHO	
	NORTH CAPE: CENTRAL	CLOSED		CLOSED	E.R.KARLUK SOCKEYE	LOCAL AND MIXED PINK			L.R.KARLUK SOCKEYE/ LOCAL & MIXED PINK	L.R.KARLUK SOCKEYE	LOCAL COHO	
NORTHWEST KODIAK DISTRICT	ANTON LARSEN	CLOSED		CLOSED	LOCAL SOCKEYE AND E.R. CHUM	LOCAL SOCKEYE, E.R. CHUM & PINK	LOCAL PINK & L.R. CHUM	LOCAL PINK/ L.R. CHUM/ COHO	LOCAL COHO			
	SHERATIN											
	KIZHUYAK											
	TERROR											
	IN. UGANIK											
	SPIRIDON											
	ZACHAR											
	UYAK											
SOUTHWEST KODIAK DISTRICT	OUT.KARLUK	CLOSED	E.R. KARLUK SOCKEYE				ODD-YEAR CYCLE: L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE	KARLUK COHO		
						EVEN-YEAR CYCLE: L.R. KARLUK SOCKEYE/PINK						
	IN.KARLUK	CLOSED	E.R. KARLUK SOCKEYE				ODD-YEAR CYCLE: L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE	KARLUK COHO		
						EVEN-YEAR CYCLE: L.R. KARLUK SOCKEYE/PINK						
	STURGEON	CLOSED			E.R.KARLUK & AYAKULIK SOCKEYE & STURGEON CHUM		ODD-YEAR CYCLE: L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE	LOCAL COHO		
							EVEN-YEAR CYCLE: L.R. KARLUK SOCKEYE/PINK					
	HALIBUT	CLOSED			E.R.KARLUK AND AYAKULIK SOCKEYE		ODD-YEAR CYCLE: L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE	LOCAL COHO		
							EVEN-YEAR CYCLE: L.R. L.R. KARLUK SOCKEYE & AYAKULIK PINK					
	OUT.AYAKULIK	CLOSED	E.R. AYAKULIK SOCKEYE				ODD-YEAR CYCLE: L.R. AYAKULIK SOCKEYE		AYAKULIK COHO			
						EVEN YEAR CYCLE: L.R. AYAKULIK SOCKEYE/PINK						
IN.AYAKULIK	CLOSED	E.R. AYAKULIK SOCKEYE				ODD-YEAR CYCLE: L.R. AYAKULIK SOCKEYE		AYAKULIK COHO				
					EVEN YEAR CYCLE: L.R. AYAKULIK SOCKEYE/PINK							
		6/1	6/9	6/16	6/23	7/6	7/16	8/1	8/16	8/25	9/6	10/31
					COMMERCIAL TEST FISHERIES			E.R. = EARLY RUN STOCKS			L.R. = LATE RUN STOCKS	



COMMERCIAL TEST FISHERIES

E.R. = EARLY RUN STOCKS

L.R. = LATE RUN STOCKS

Table 8. Primary management species and fishery chronology of the Eastside Afognak Management Plan for the Kodiak Management Area, 1993.

TARGETED SPECIES BY SYSTEM AND TIME FOR SPECIFIC MANAGEMENT UNITS ^{1/}													
S.E. AFOGNAK SECTION (Seine)	LITNIK SOCKEYE	X	X	LITNIK SOCKEYE	X	X	LITNIK SOCKEYE	LOCAL PINK					LOCAL COHO
DUCK BAY SECTION (Seine)	EARLY HATCHERY CHUM AND/OR SOCKEYE						HATCHERY & LOCAL PINK					LOCAL COHO	
IZHUT BAY SECTION (Seine)	EARLY HATCHERY CHUMS AND/OR SOCKEYE						CLOSED UNTIL COST RECOVERY ASSURED		HATCHERY & LOCAL PINK			LOCAL COHO & HATCHERY SOCKEYE	
KITOI BAY SECTION ^{2/} (Seine) Broodstock								a					
PINK: Cost Recovery							b						
Common Property							c						
----- CHUM &/OR Broodstock EARLY SOCKEYE					d								
Common Property	e												
----- COHO & SOCKEYE: Broodstock											f		
Common Property											g		
6/9 6/14 6/20 7/1 7/3 7/6 7/18 7/20 7/25 8/1 8/8 8/15 8/20 8/24 9/1													

☒ - fishing time dependant upon sockeye escapement into Litnik system.

- Included in this management plan are the harvest strategies for current natural and hatchery production as well as future hatchery production.
- The management plan required for the Kitoi Bay Section is rather complicated in order to achieve broodstock, cost recovery, and common harvest requirements. This is further complicated by the multispecies production currently occurring at Kitoi Bay hatchery. The diagram shown attempts to approximate dates for when specific management strategies should be implemented to insure achievement of hatchery goals and an orderly harvest of quality common property fish.
 - Hatchery pink salmon broodstock captured.
 - Hatchery pink salmon cost recovery fishery when necessary.
 - Hatchery pink salmon common property fishery.
 - Hatchery chum and/or early sockeye salmon broodstock captured.
 - Hatchery chum and/or early sockeye salmon common property fishery.
 - Hatchery coho and late sockeye salmon broodstock captured.
 - Hatchery coho and late sockeye salmon common property fishery.

Table 9. Sockeye salmon escapement goals for major and minor systems in millions of fish, for the Kodiak Management Area, 1993.

	<u>Early Run (Before 7/15)</u>		<u>Late Run (After 7/15)</u>		<u>Total</u>	
	Minimum	Desired	Minimum	Desired	Min.	Des.
Major Systems						
Karluk ^b	.150	.250	.400	.550	.550	.800
Ayakulik	.160	.220	.040	.080	.200	.300
Upper Station ^b	.050	.075	.150	.200	.200	.275
Frazer ^c	.140	.200	-	-	.140	.200
Subtotal	.500	.745	.590	.830	1.090	1.575
Minor Systems						
Akalura ^b	.010	.015	.030	.045	.040	.060
Saltery ^c	.020	.040	-	-	.020	.030
Buskin ^c	.010	.015	-	-	.010	.015
Litnik ^c	.040	.060	-	-	.040	.060
Pauls ^c	.020	.040	-	-	.020	.040
Thorsheim ^c	.005	.010	-	-	.005	.010
Subtotal	.015	.180	.030	.045	.120	.205
GRAND TOTAL	.605	.925	.620	.875	1.225	1.790

^a This listing of systems identifies only those systems whose escapement is monitored by fish weir total escapement counts. The escapement into these systems represents approximately 85% of the Kodiak Area's total sockeye escapement.

^b Sockeye escapement into these systems characterized by two (2) more or less distinct stocks as identified by bimodal escapement pattern, i.e. an early stock where the cumulative escapement occurs through July 15 and a late stock where the cumulative escapement occurs primarily from July 16 through season's end.

^c Sockeye escapement into these systems characterized by one (1) distinct escapement pattern and where escapement is essentially completed by approximately July 25. Escapement goals for Pauls Bay are currently being reevaluated.

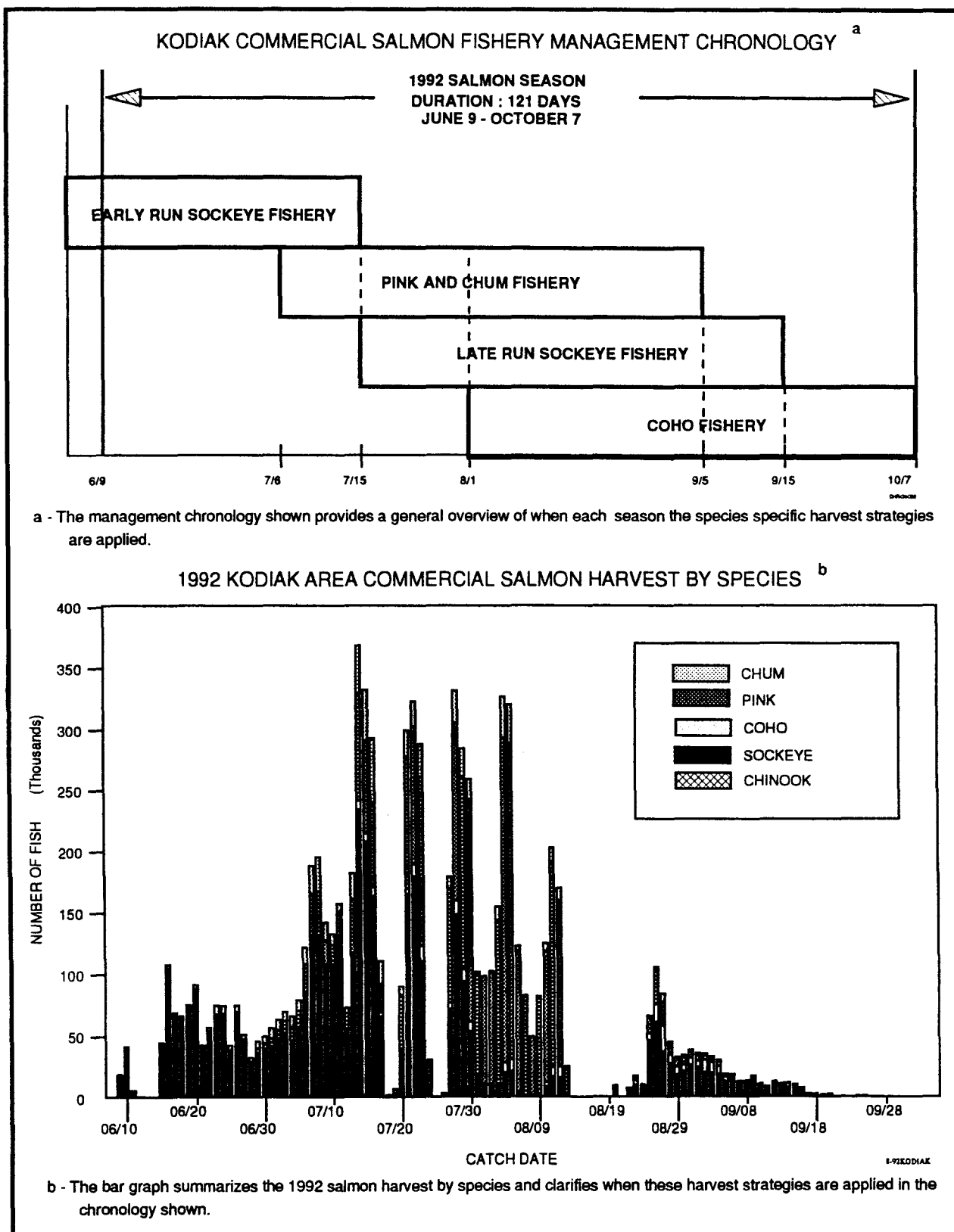


Figure 1. Salmon management chronology and commercial harvest by species in the Kodiak Management Area, 1992.

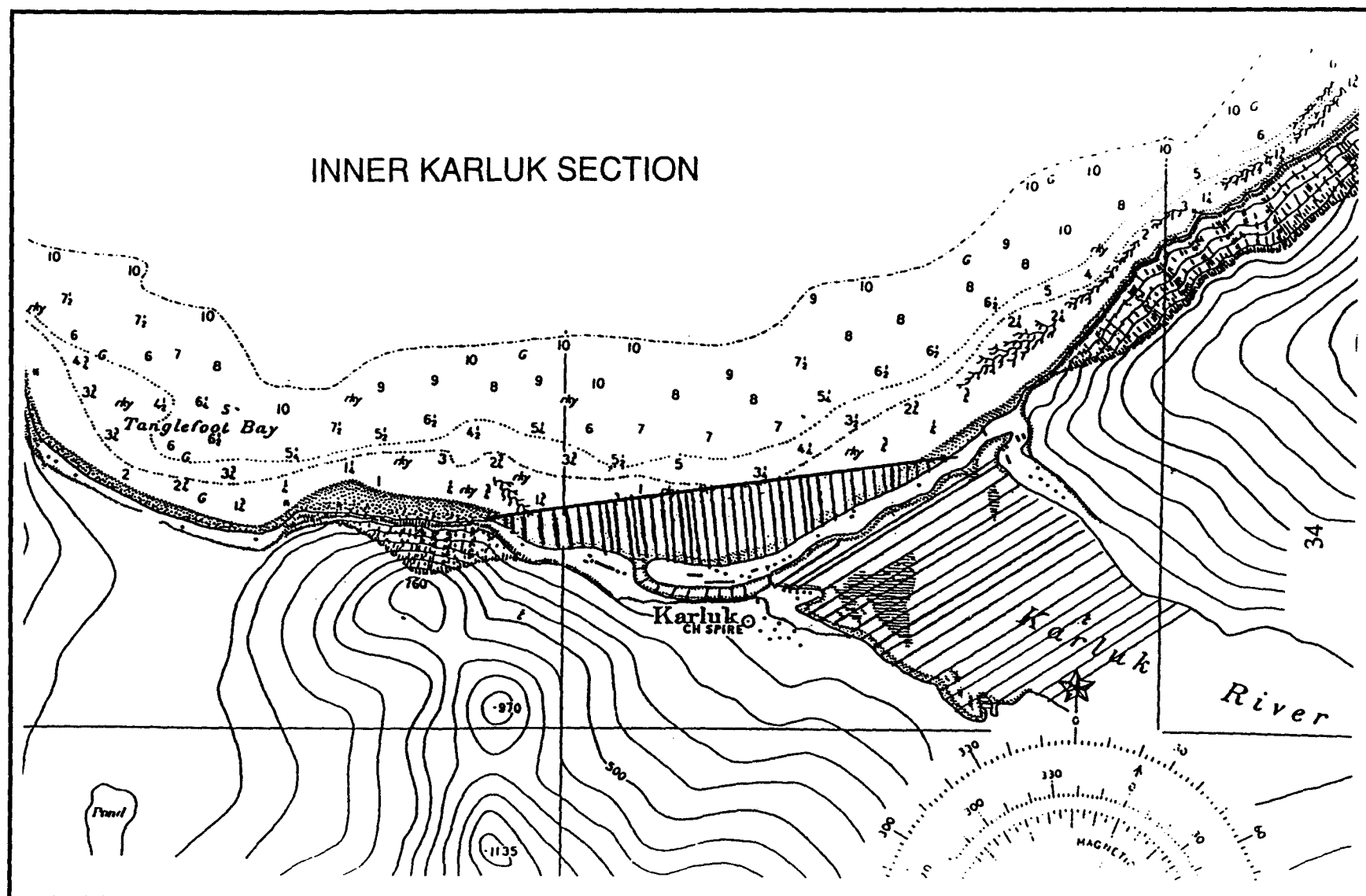


Figure 2. Karluk River closed water sanctuary in the Kodiak Management Area, 1993.

ALASKA DEPARTMENT OF FISH AND GAME
BUSKIN RIVER CLOSED WATER SANCTUARY
FOR THE COMMERCIAL AND SUBSISTENCE
SALMON FISHERY

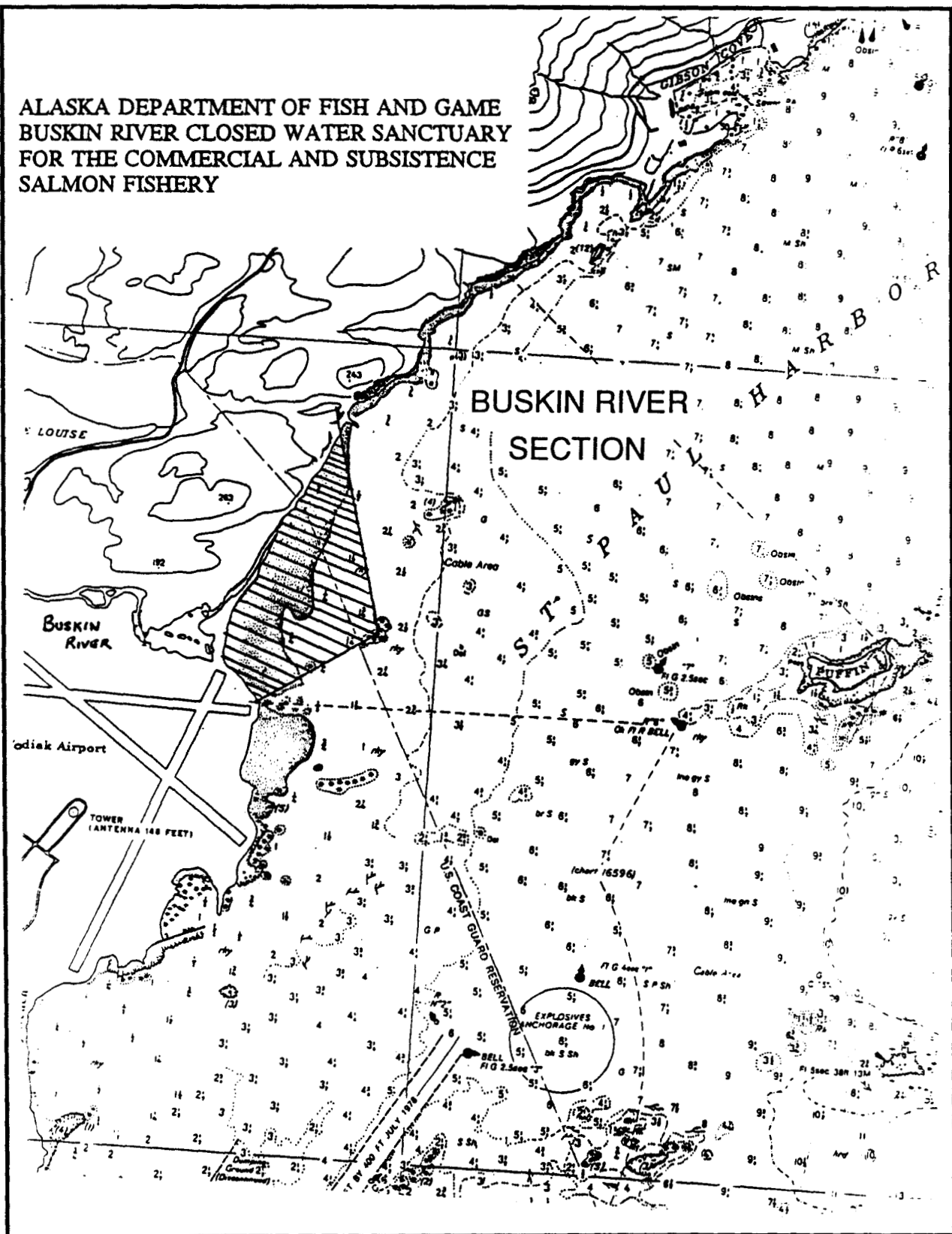


Figure 3. Buskin River closed water sanctuary in the Kodiak Management Area, 1993.

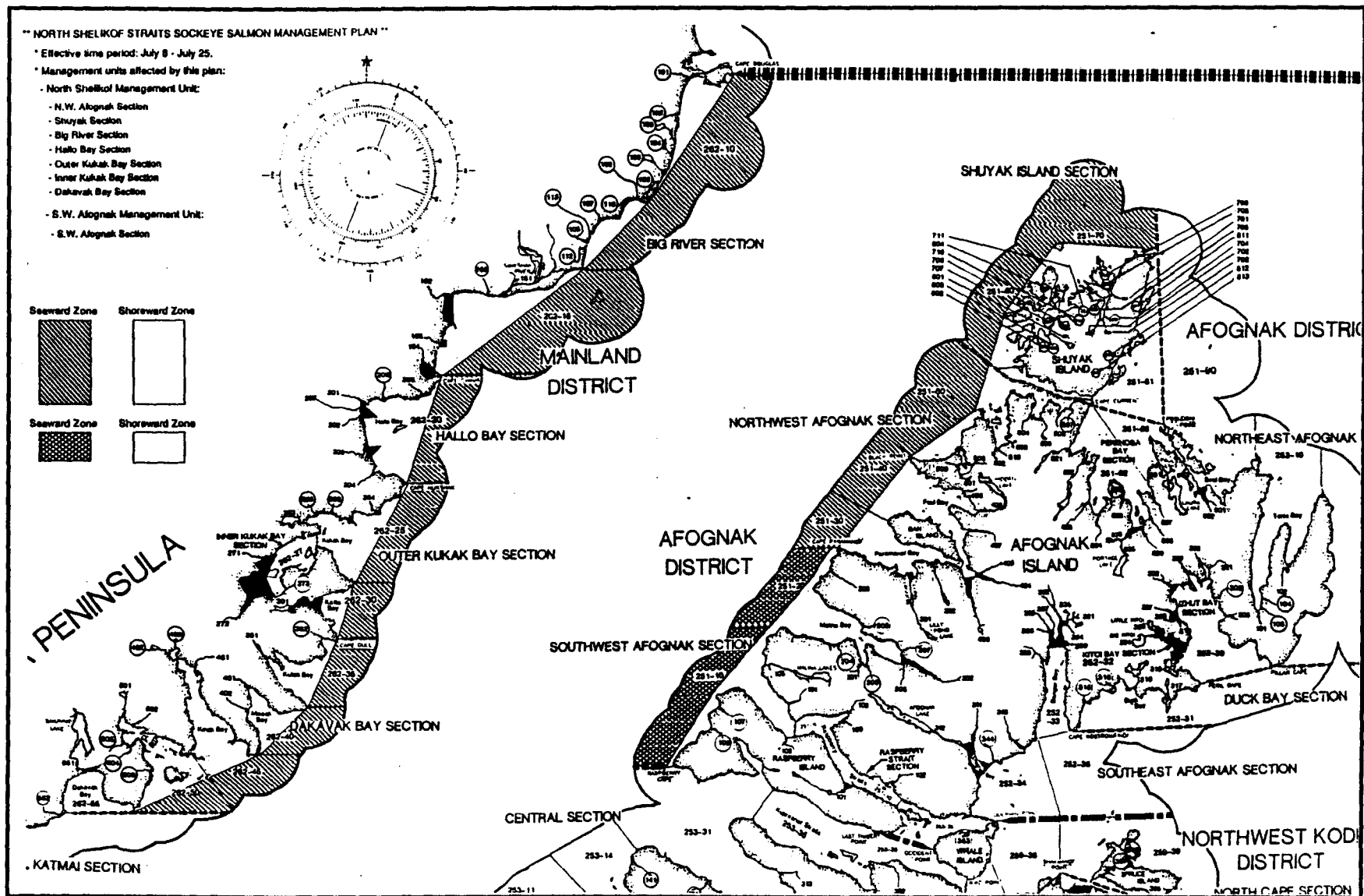


Figure 4. Approximate boundaries of the "North Shelikof Seaward Zone" and the "Southwest Afognak Seaward Zone" of the North Shelikof Strait Sockeye Salmon Management Plan for the Kodiak Management Area, 1993.

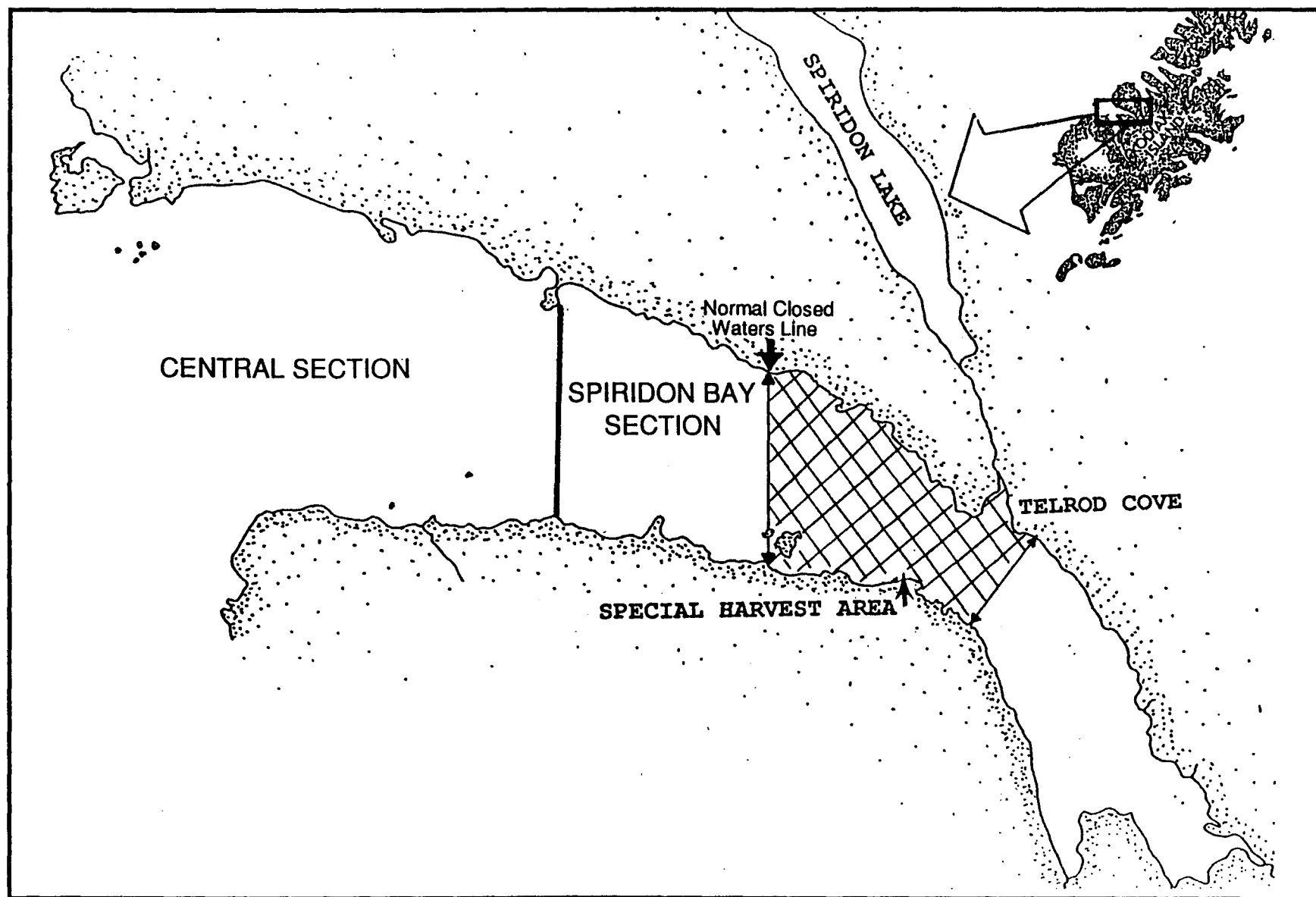
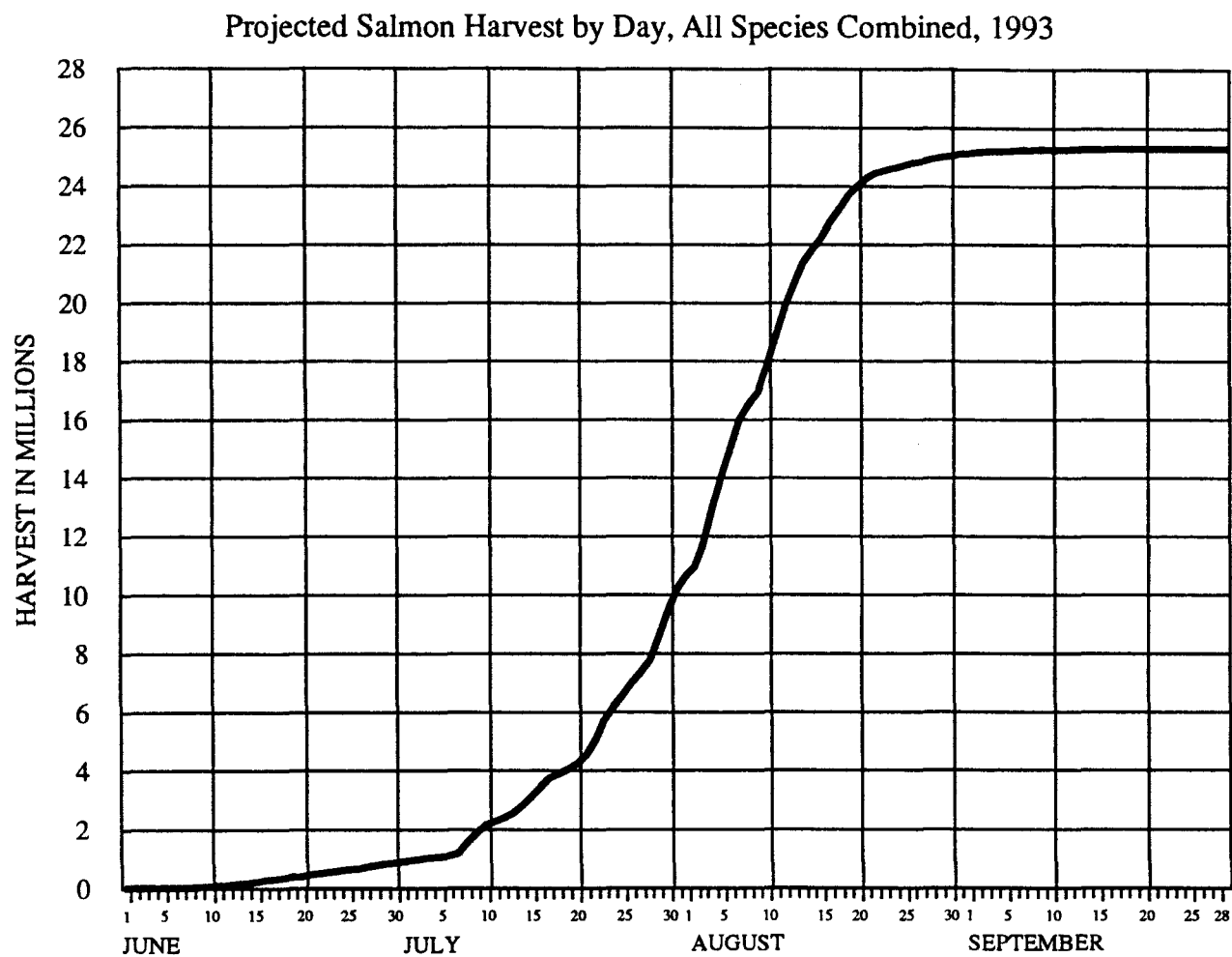


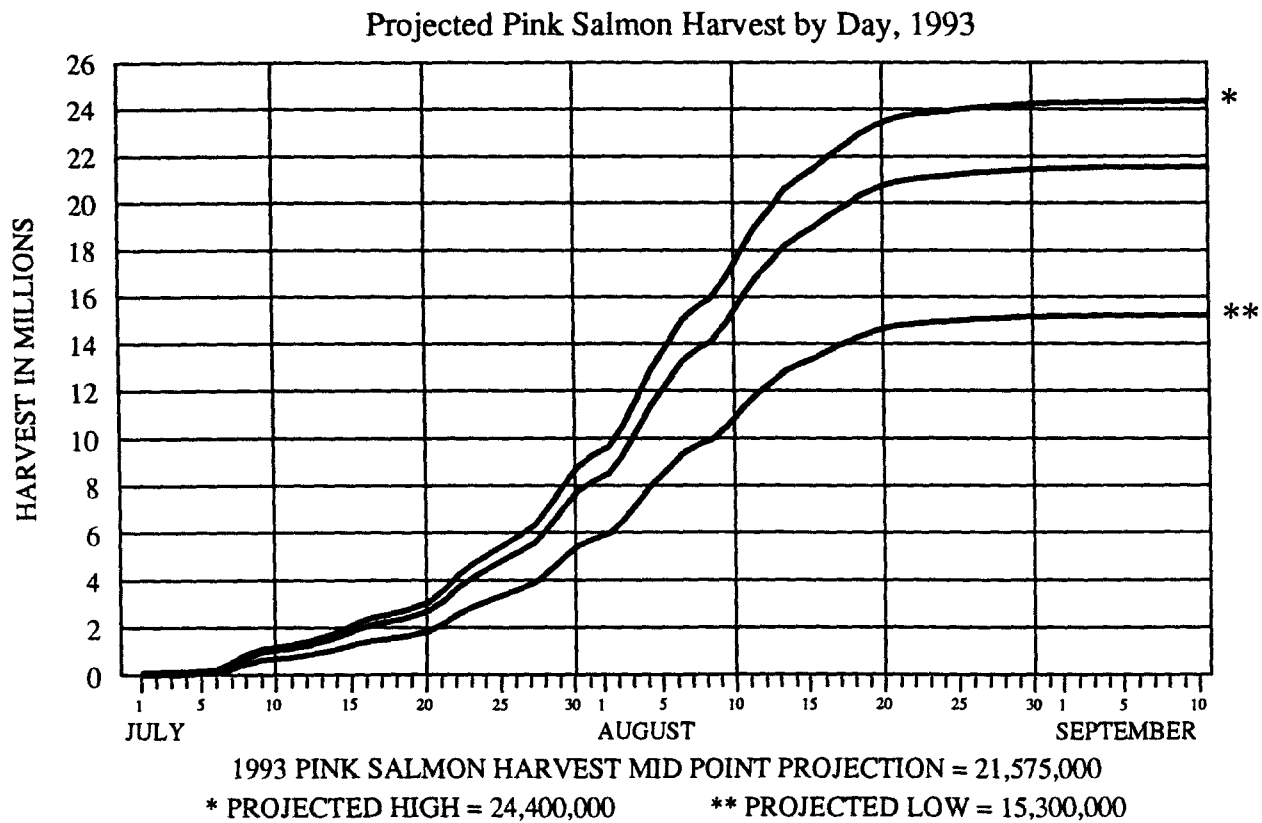
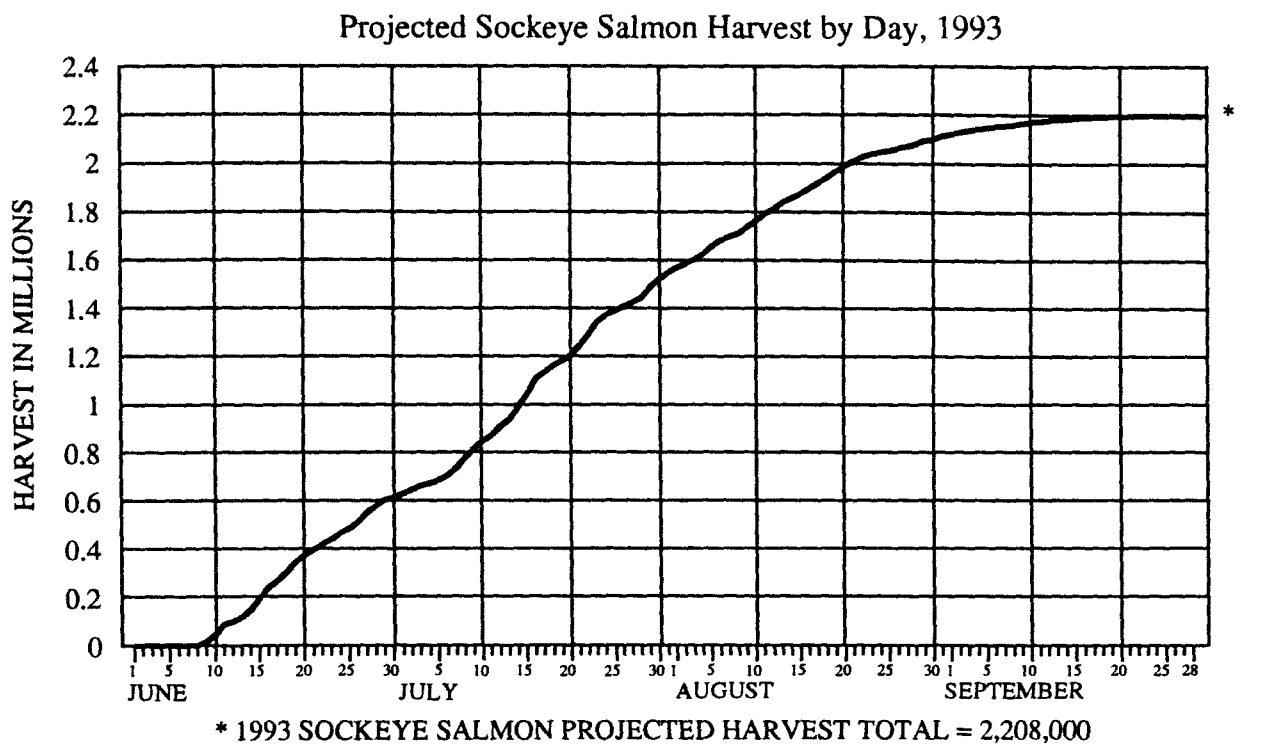
Figure 5. Approximate boundaries of the Special Harvest Area of the Spiridon Bay Sockeye Salmon Management Plan for the Kodiak Management Area, 1993.

APPENDIX

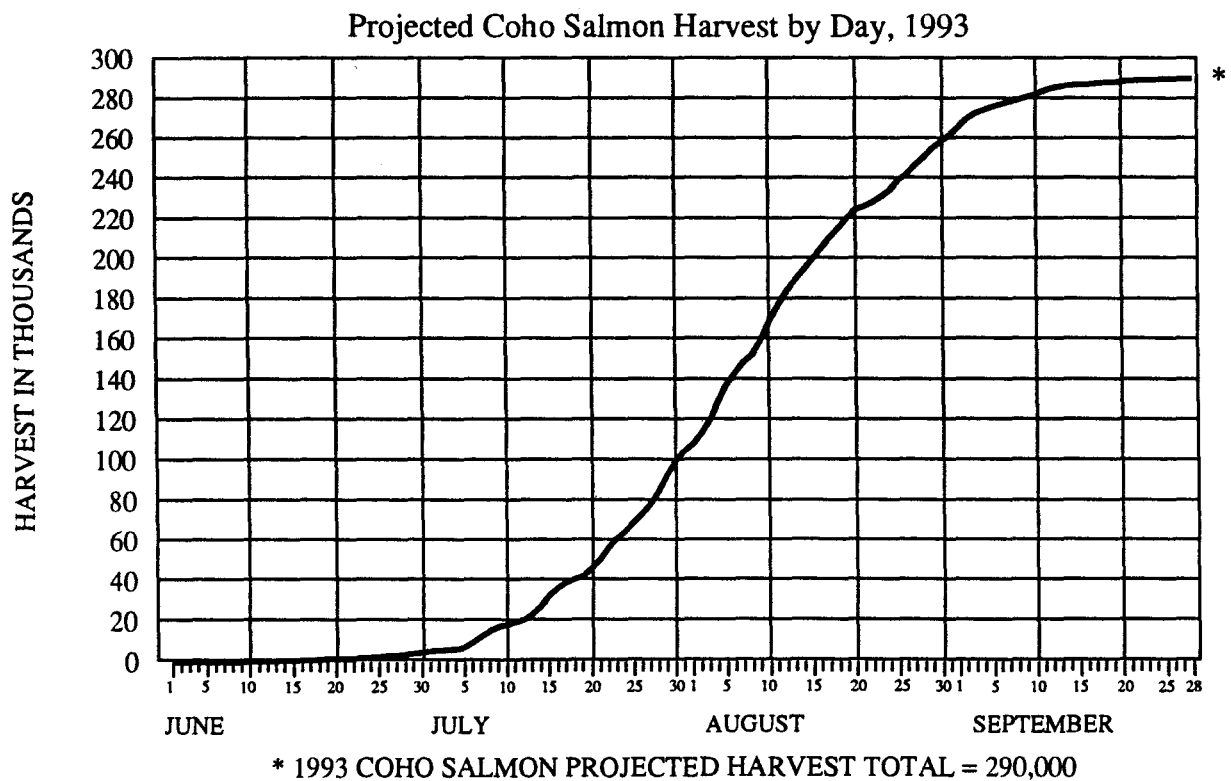
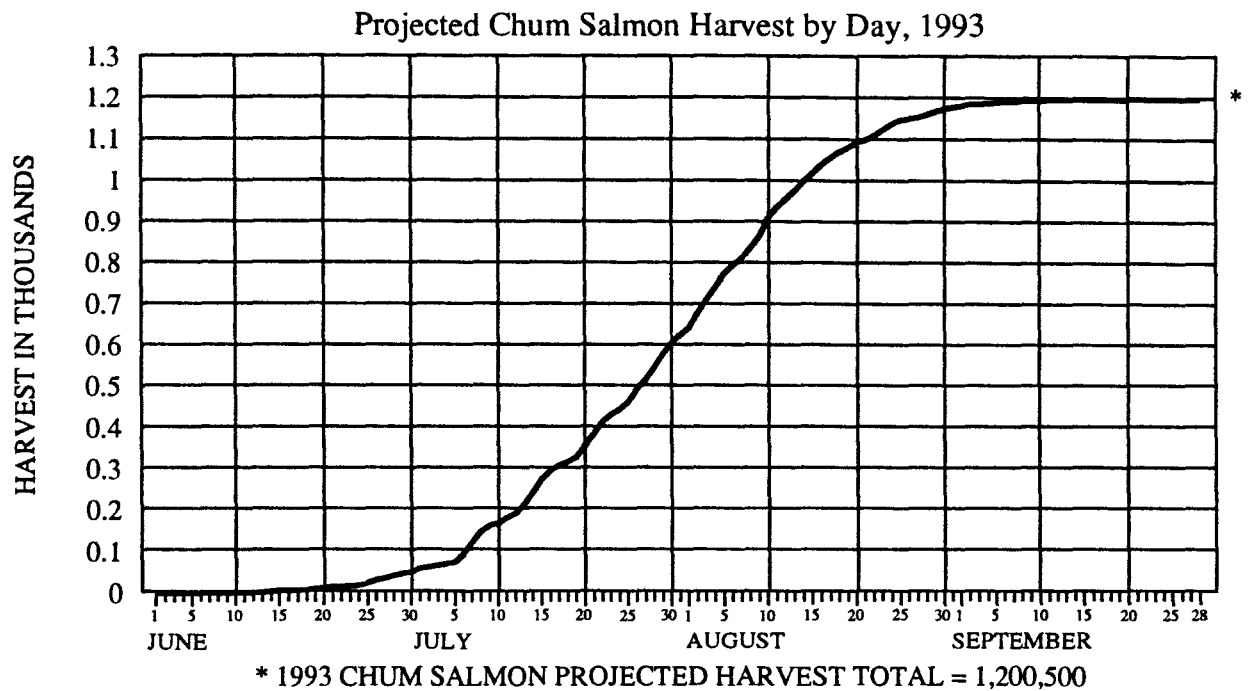


* 1993 ALL SALMON SPECIES PROJECTED HARVEST TOTAL = 25,294,500

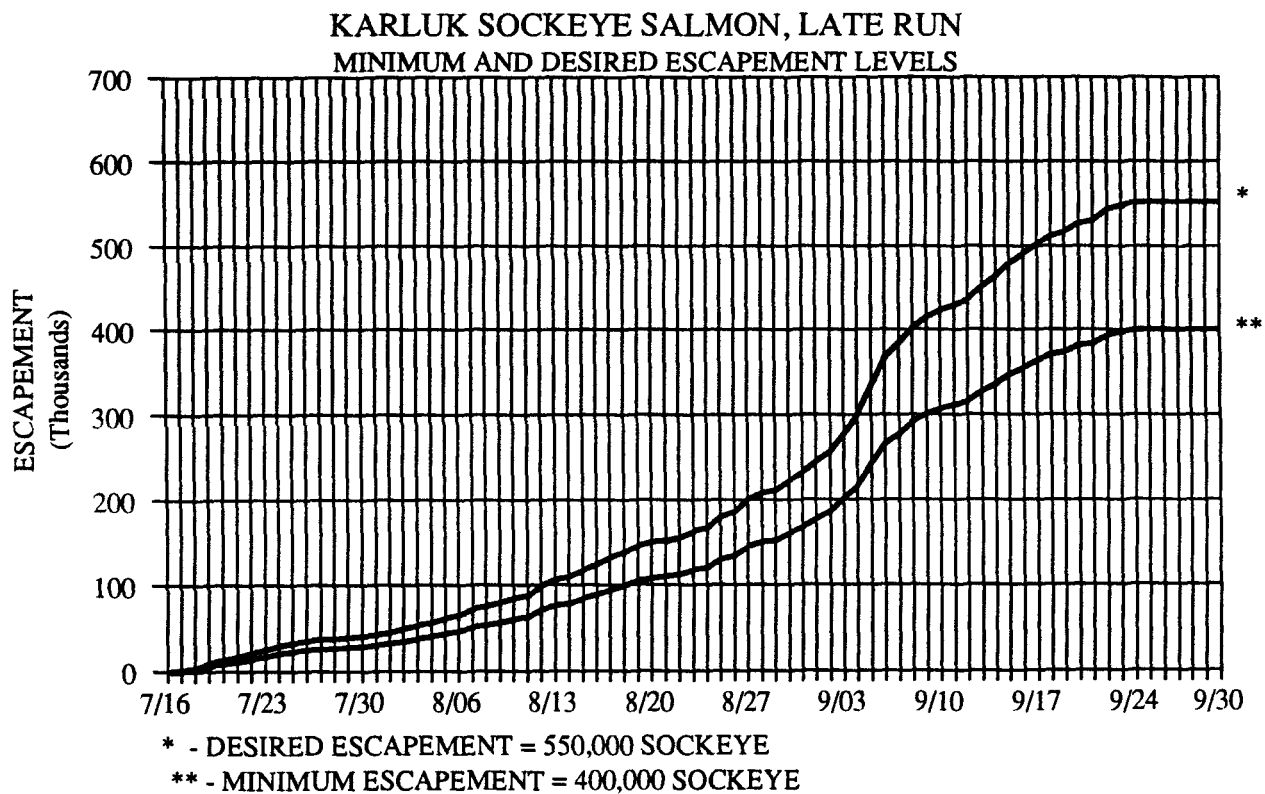
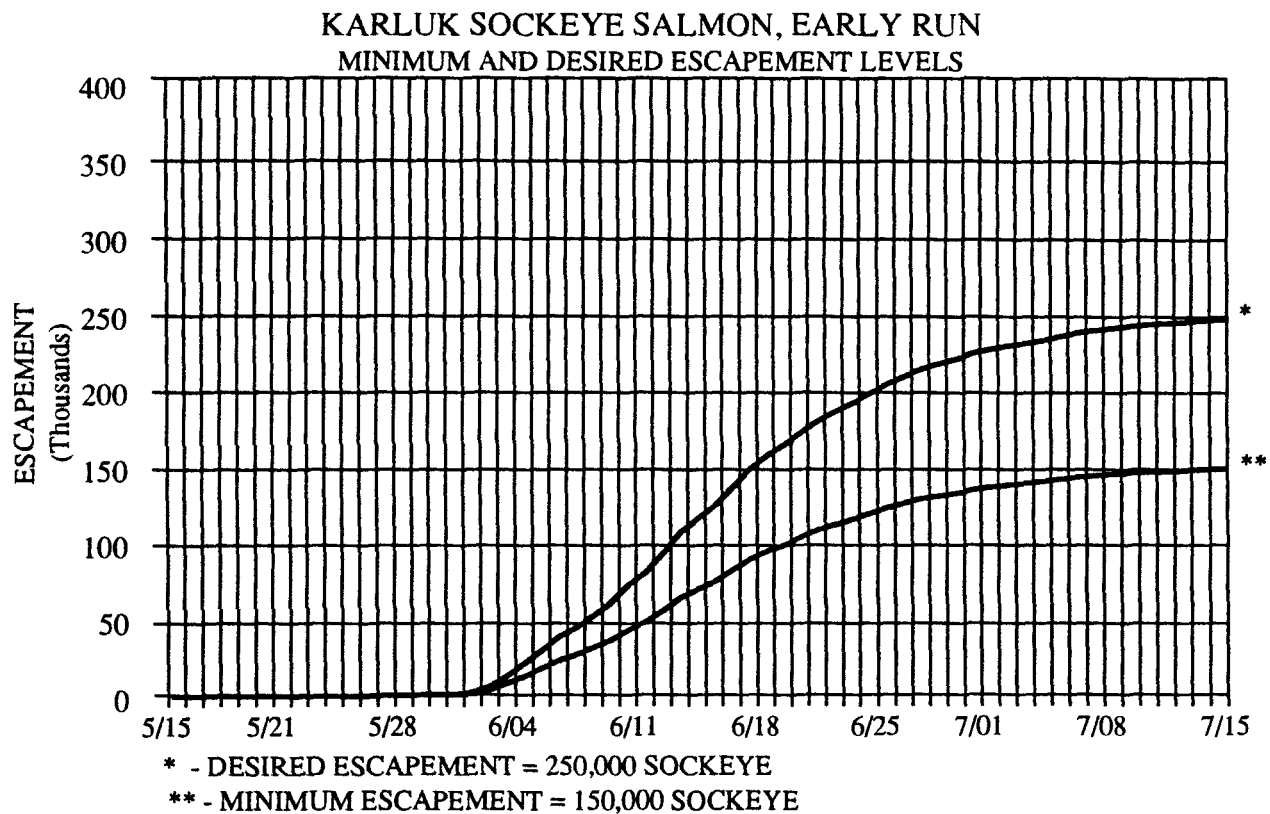
Appendix A.1. Projected salmon harvest graph, all species combined, for the Kodiak Management Area, 1993



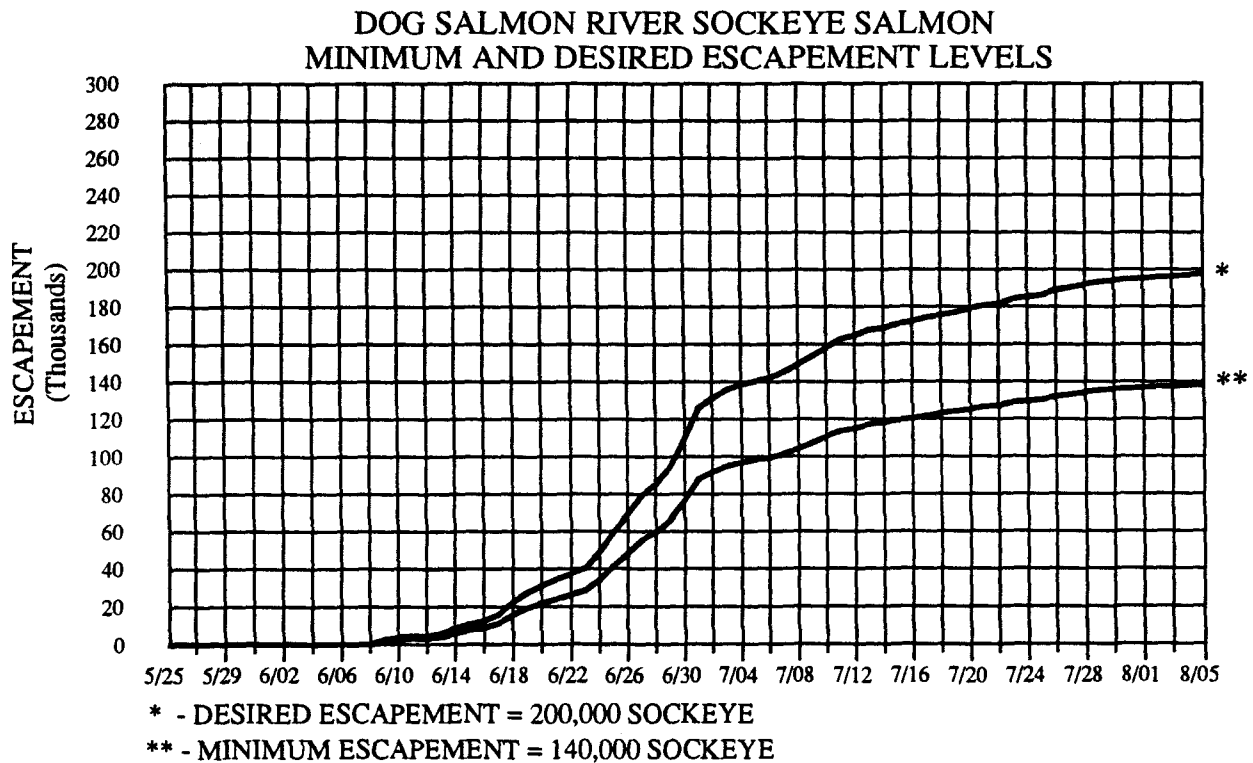
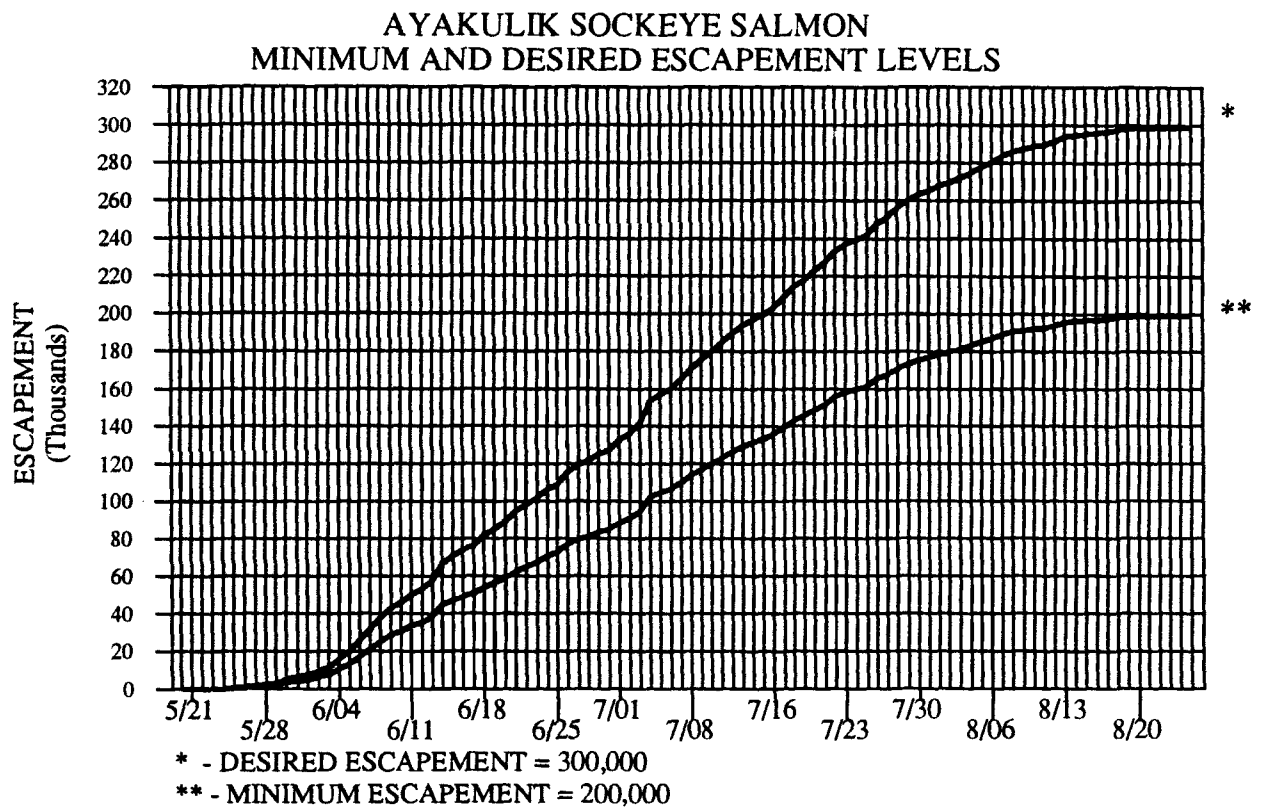
Appendix A.2. Projected sockeye and pink salmon harvest graphs for the Kodiak Management Area, 1993



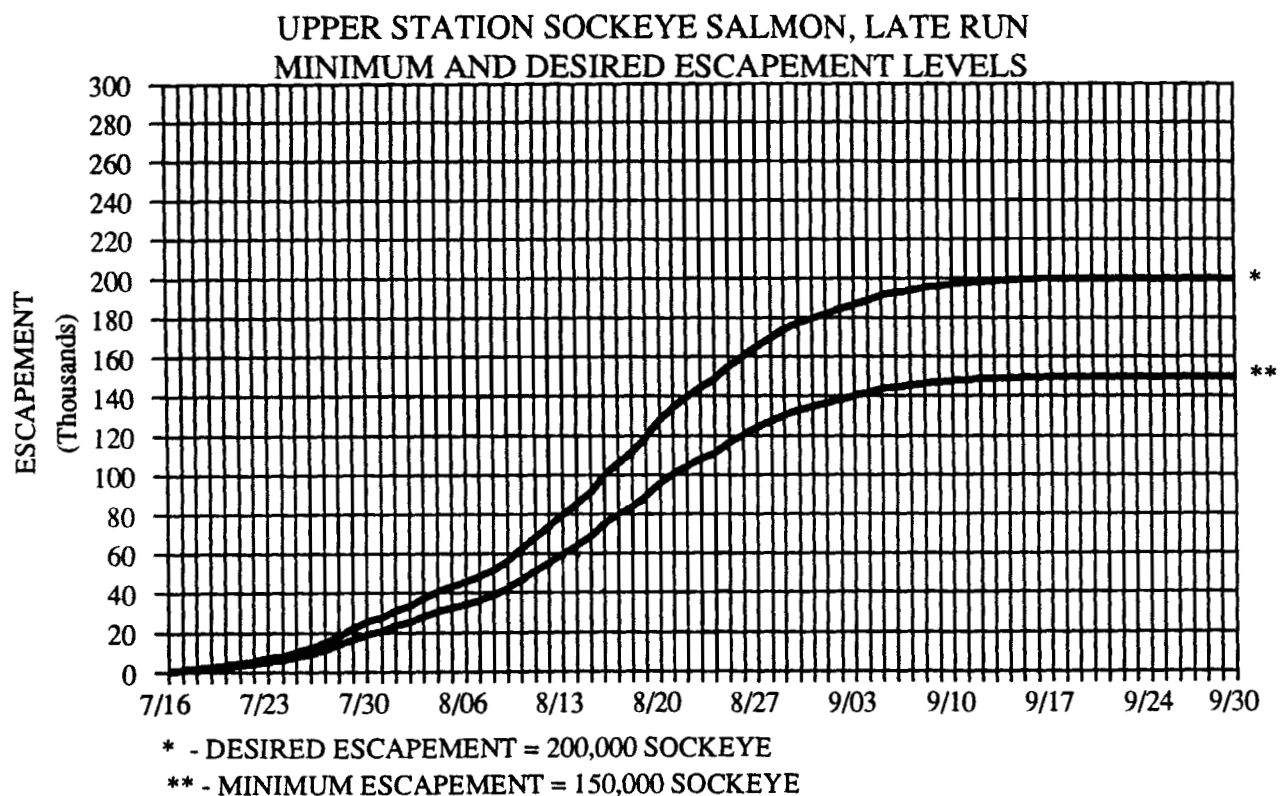
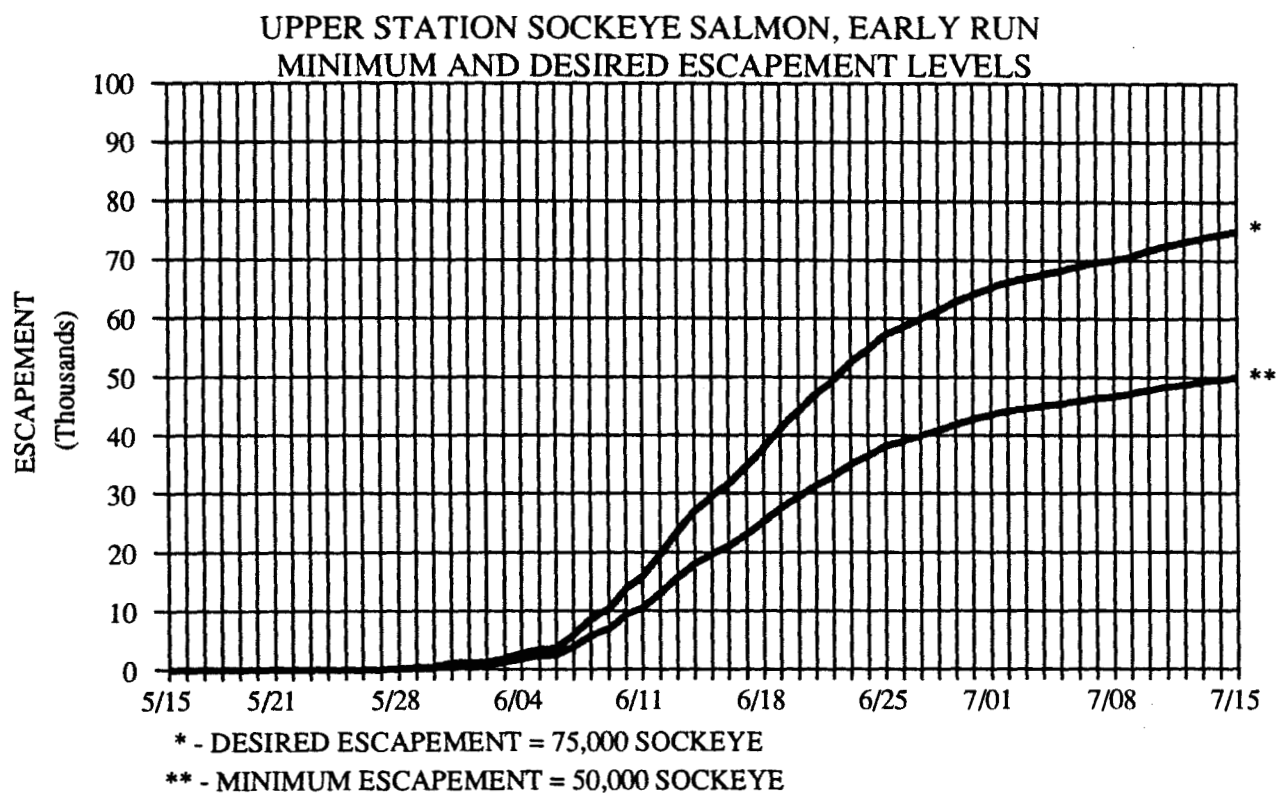
Appendix A.3. Projected chum and coho salmon harvest graphs for the Kodiak Management Area, 1993



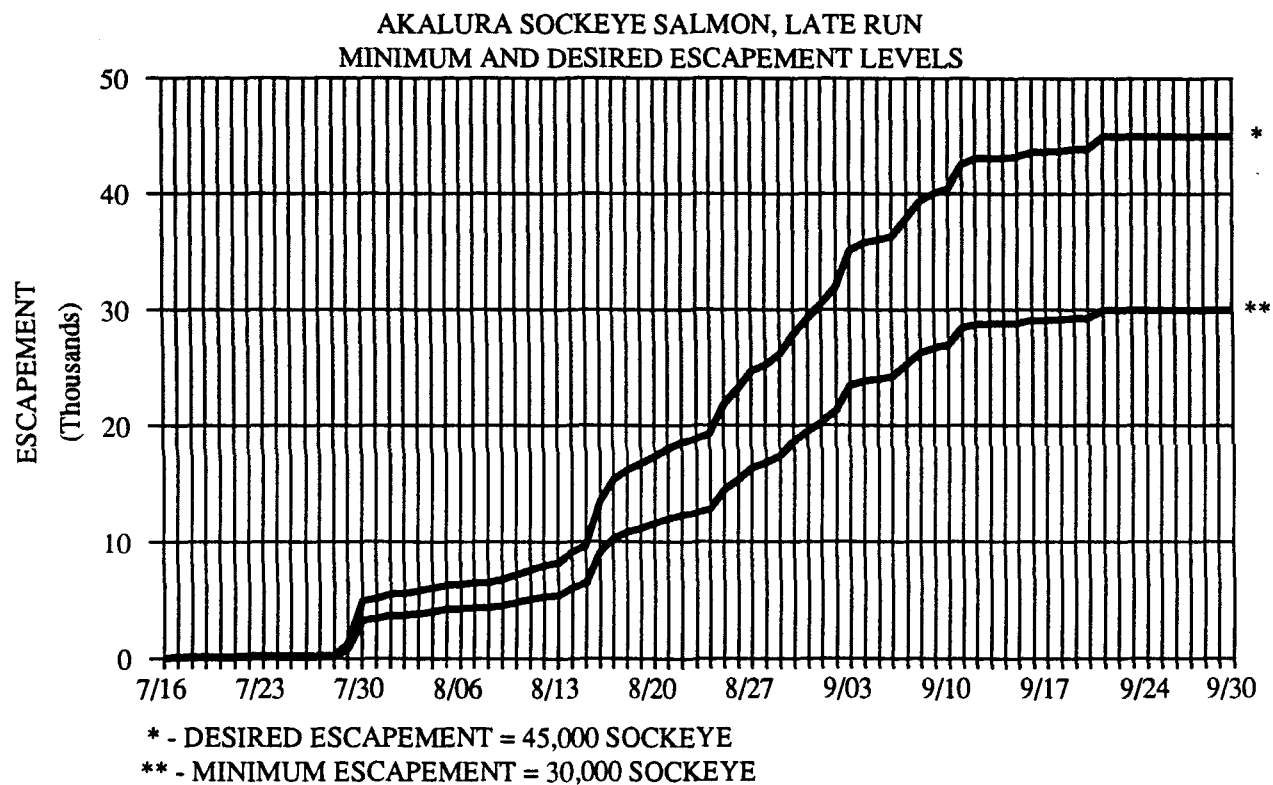
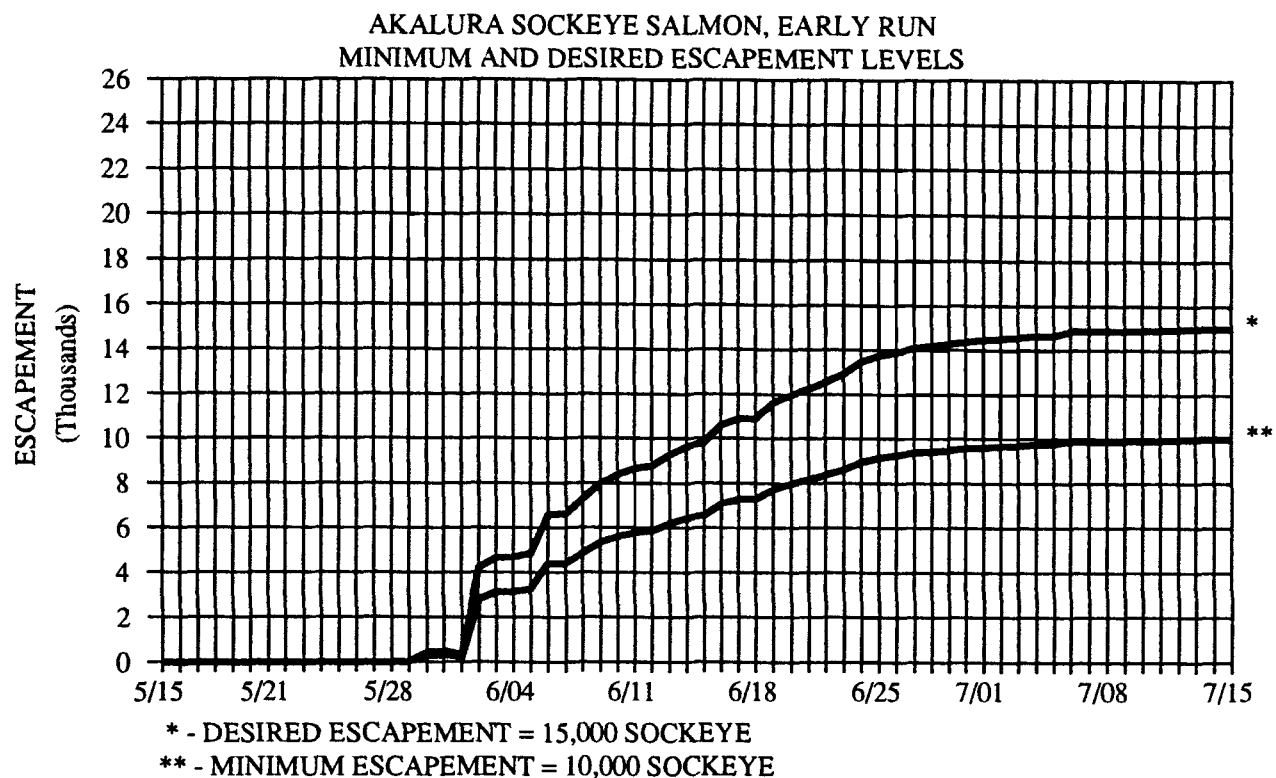
Appendix B.1. Minimum and desired escapement graphs for Karluk sockeye salmon of the Kodiak Management Area, 1993.



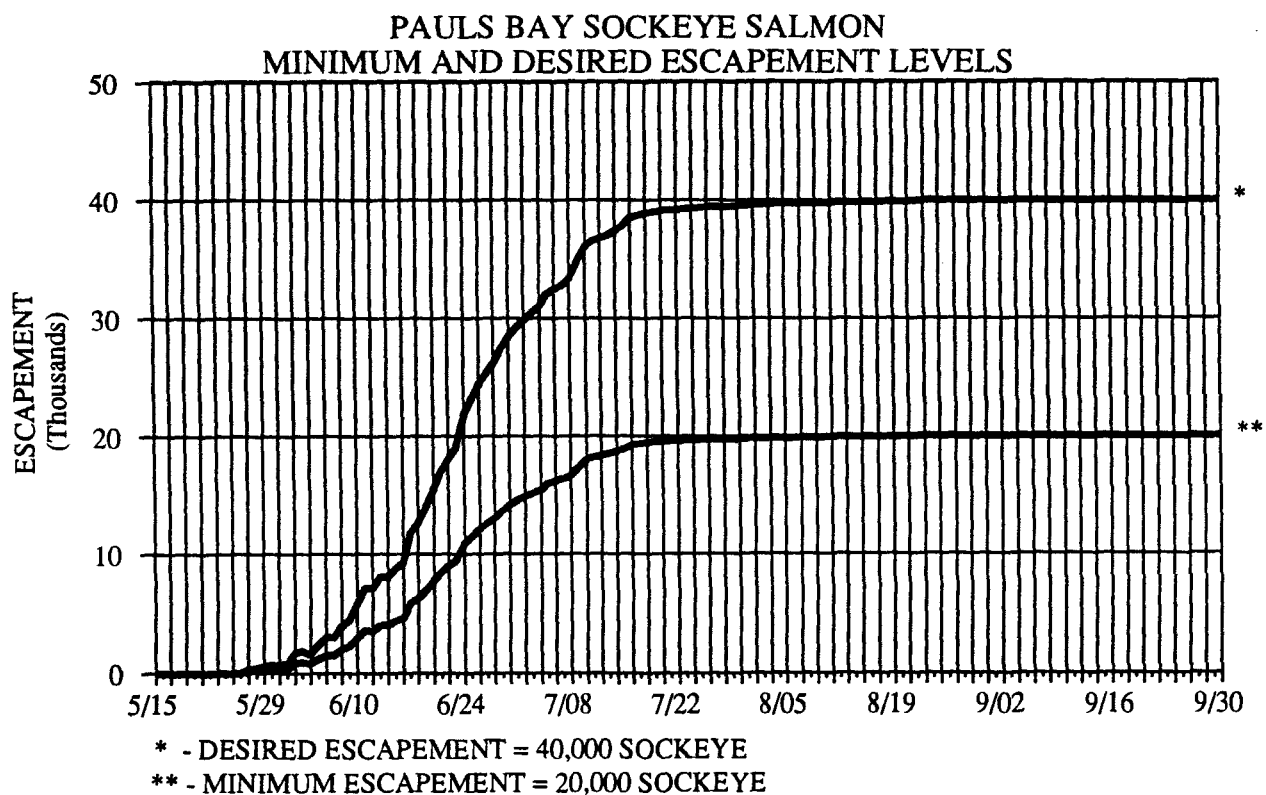
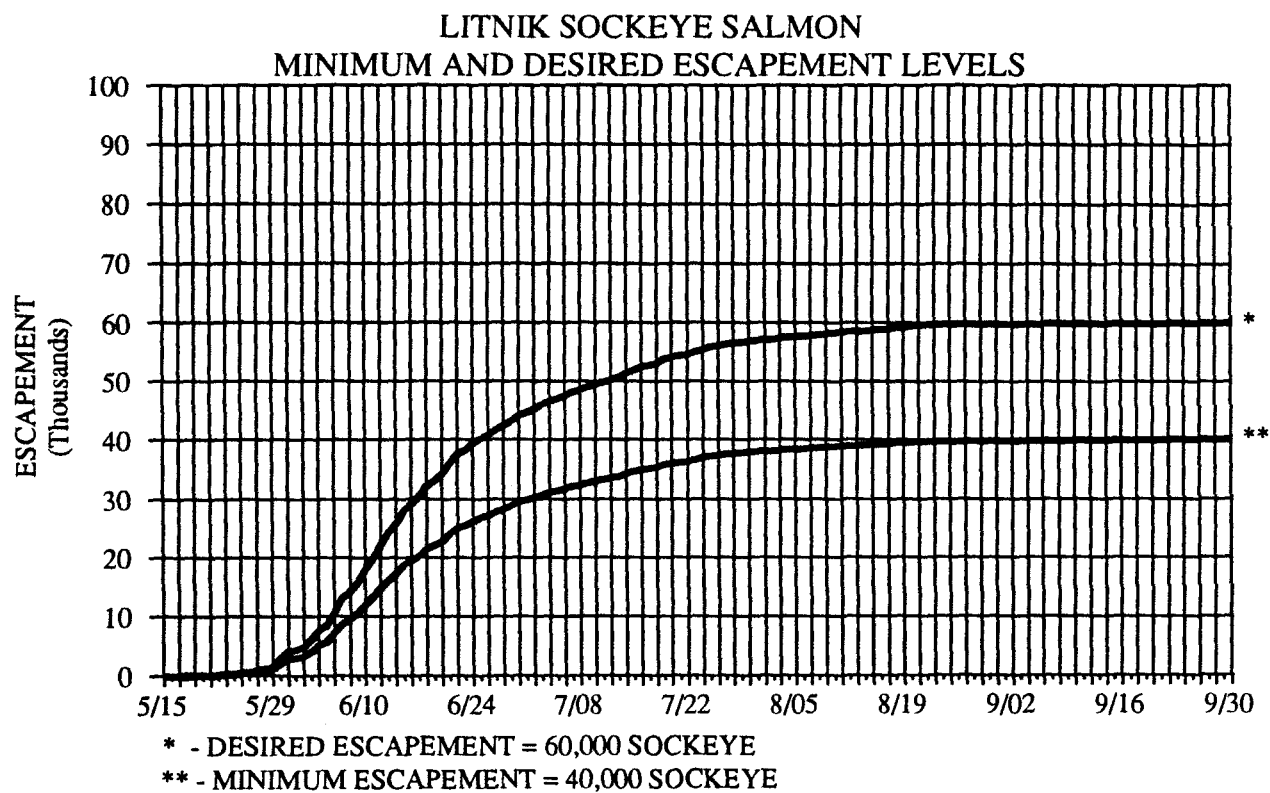
Appendix B.2. Minimum and desired escapement graphs for Ayakulik and Frazer sockeye salmon of the Kodiak Management Area, 1993.



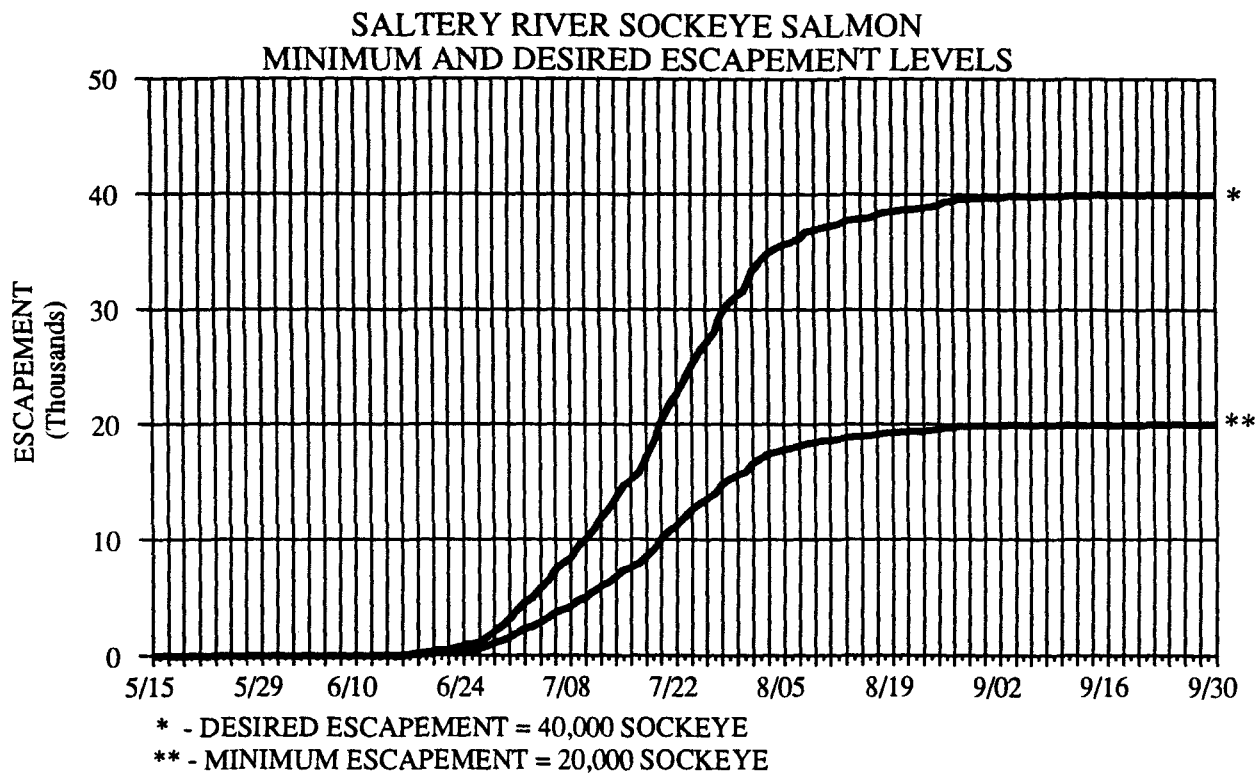
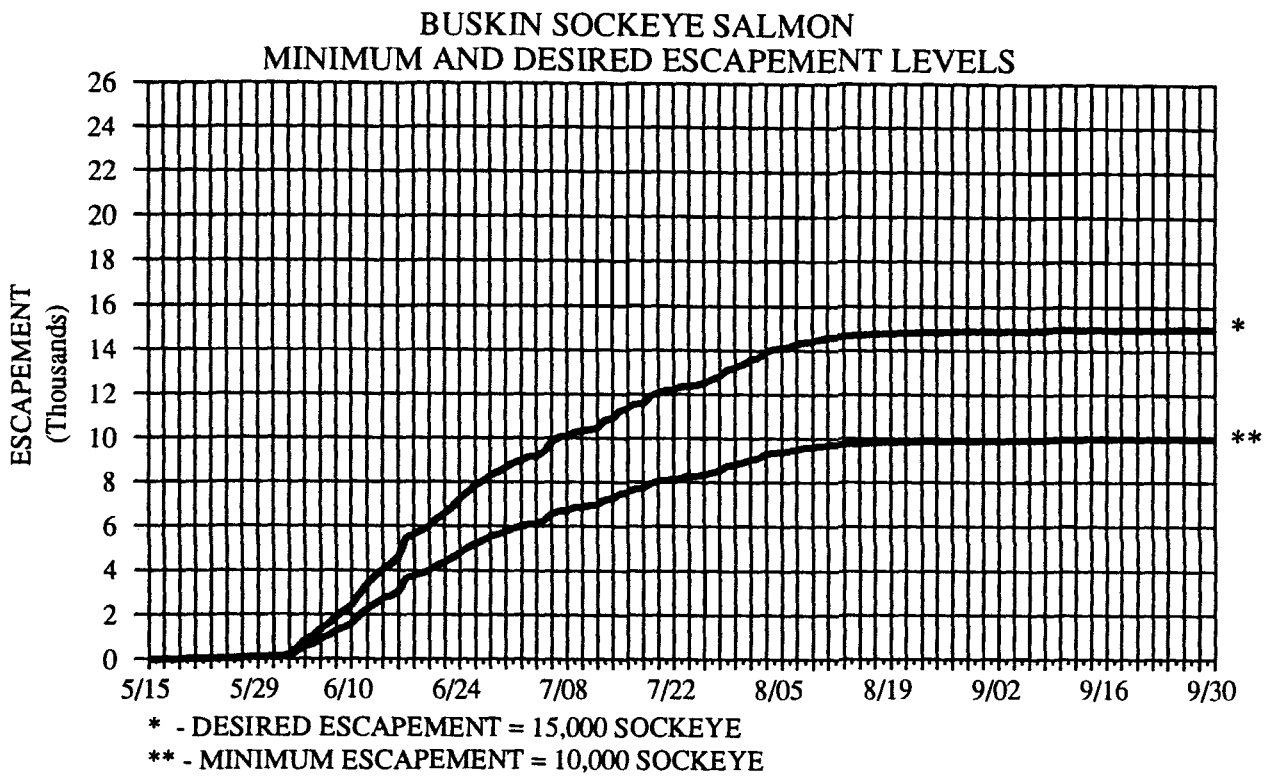
Appendix B.3. Minimum and desired escapement graphs for Upper Station sockeye salmon of the Kodiak Management Area, 1993.



Appendix B.4. Minimum and desired escapement graphs for Akalura sockeye salmon of the Kodiak Management Area, 1993.



Appendix B.5. Minimum and desired escapement graphs for Litnik and Pauls Bay sockeye salmon of the Kodiak Management Area, 1993.



Appendix B.6. Minimum and desired escapement graphs for Buskin and Saltery sockeye salmon of the Kodiak Management Area, 1993.

KODIAK MANAGEMENT AREA SALMON ESCAPEMENT SAMPLING

OPERATIONAL PLAN, 1993



Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska 99615

MAY 1993

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INTRODUCTION

Annually, sockeye and coho salmon escapements are sampled for age, length, and sex from major and minor systems by field personnel within the Kodiak Management Area. Management and research biologists rely on this data for forecasting, escapement goal evaluation, catch apportionment, and run timing estimation. As the demand on our salmon resource increases, so does the intrinsic value of this data.

During the last several years, stock identification projects using scale pattern analysis have been conducted within the Alitak Bay, Afognak, and Mainland Districts. The foundation for these projects are the scale samples that are collected. It is imperative that scales collected be of the highest quality possible.

GOAL

Provide improved management of the Kodiak Management Area salmon runs by optimizing escapement requirements thereby insuring maximum harvest opportunities.

OBJECTIVES

1. Construct accurate brood tables (spawner-recruitment relationships).
2. Develop accurate run forecasts.
3. Evaluate escapement goals and accurately define run timing.
4. Provide samples suitable for scale pattern analysis as required for addressing mixed stock fishery issues.

TASKS

1. Collect representative age, length, and sex data from all major and selected minor sockeye salmon systems within the Kodiak Management Area (KMA).
2. Similarly, collect data for coho salmon escapements from selected systems in the KMA.

SUPERVISION

Area Research Biologist, Charles Swanton will supervise escapement sampling at Frazer Fishpass and Akalura weir. All other KMA escapement crews will be directly supervised by Kodiak Management Area staff. Biologist Patricia Nelson will monitor weekly escapement sampling and review incoming data for quality, quantity, and timeliness. A log book will be maintained tracking weekly samples, and weir crew leader's will be notified weekly regarding data quality.

PROCEDURES

Sockeye

Weekly sockeye salmon escapement sampling for age, length, and sex (ALS), will be conducted at Karluk River, Upper Station, Ayakulik River, and Frazer Lake (Figure 1). Samples will be collected using a live box trap (Figure 2) according to the schedules in Table 1. If the required number of fish are not taken within a single day, obtain the balance of the sample on the following day.

Minor systems will be sampled with reduced intensity. Pauls Bay staff will collect one 480 fish beach seine sample during peak escapement. Litnik (Afognak) and Akalura weir personnel will collect two 480 fish samples from both early and late sockeye run components. A single 600 fish sample will be collected at the Saltery weir during the peak escapement subject to staff availability. Sport Fisheries Division (S.F.D.) personnel will sample the Buskin River sockeye escapement with a goal of 140 fish every two weeks, for six weeks (sample size specified by S.F.D. biometrician). S.F.D. will similarly sample the Buskin River sockeye subsistence harvest. Malina Lake weir, operated by FRED Section, will collect one 480 fish sample during peak escapement.

Remote sampling at Uganik Lake is contingent upon approved funding for determining local stock contributions to July interception fisheries.

It is essential that all ALS data be representative of the true escapement, therefore avoid bias by NOT pre-selecting fish based upon size, sex, condition or any other factor. Sampling and recording procedures are presented in Appendix A.

Coho

Coho escapement samples will be collected at Litnik, Karluk, Ayakulik, Upper Station, and Dog Salmon weirs. A total of 280 coho will be sampled (two scales per fish) at each location within a 10 day period during peak escapement. Sport Fisheries Division staff will sample 140 fish from

the Buskin River, every three weeks, from August 15 through October 1. Additionally, S.F.D. will collect a 140 fish beach seine sample in October from Buskin Lake (sample size specified by S.F.D biometrician).

DATA REPORTING

Crew leaders will notify Dave Prokopowich or Kevin Brennan via SSB radio upon completion of weekly sampling. Karluk weir will mail completed ALS data to Kodiak (return receipt from the Karluk village post office), and notify the office of the mailing date (via radio). All other field camp personnel will send completed samples back to town on return grocery flights. These packages should be clearly labeled to include: system, sample dates, and Attn.: Patti Nelson. The pilot should be notified to call Fish and Game at 486-1808 or 486-1855 for package pick up.

Table 1. Sockeye salmon escapement sampling schedule, 1993.

Location	Sampling Frequency	Date		Sample Size
		Starting	Ending	
Akalura weir (early)	once	May 15	Jul 15	480
Akalura weir (late)	once	Jul 16	Sep 15	480
Ayakulik weir	weekly	May 30	Sep 30	240
Buskin Lake weir ^a	biweekly	Jun 01	Aug 01	140
Buskin Subsistence Harvest	biweekly	Jun 01	Aug 01	140
Frazer Fishpass	weekly	Jun 15	Aug 30	240
Karluk weir	weekly	May 30	Sep 30	240
Litnik (Afognak) weir (early)	once	Jun 07	Jun 15	480
Litnik (Afognak) weir (late)	once	Jul 14	Jul 20	480
Malina Lake weir ^b	once	Jun 02	Sep 30	480
Pauls Bay	once	Jun 06	Jul 03	480
Saltery River weir ^c	once	Jul 07	Jul 20	600
Upper Station	weekly	Jun 06	Sep 30	240
Uganik Lake ^d	once	Jul 05	Jul 26	600

^a Sampled by Sport Fisheries Division (sample size determined by S.F.D. Biometrician).

^b Sampled by FRED.

^c Subject to staff availability.

^d Contingent upon funding sources for addressing the July interception fisheries.

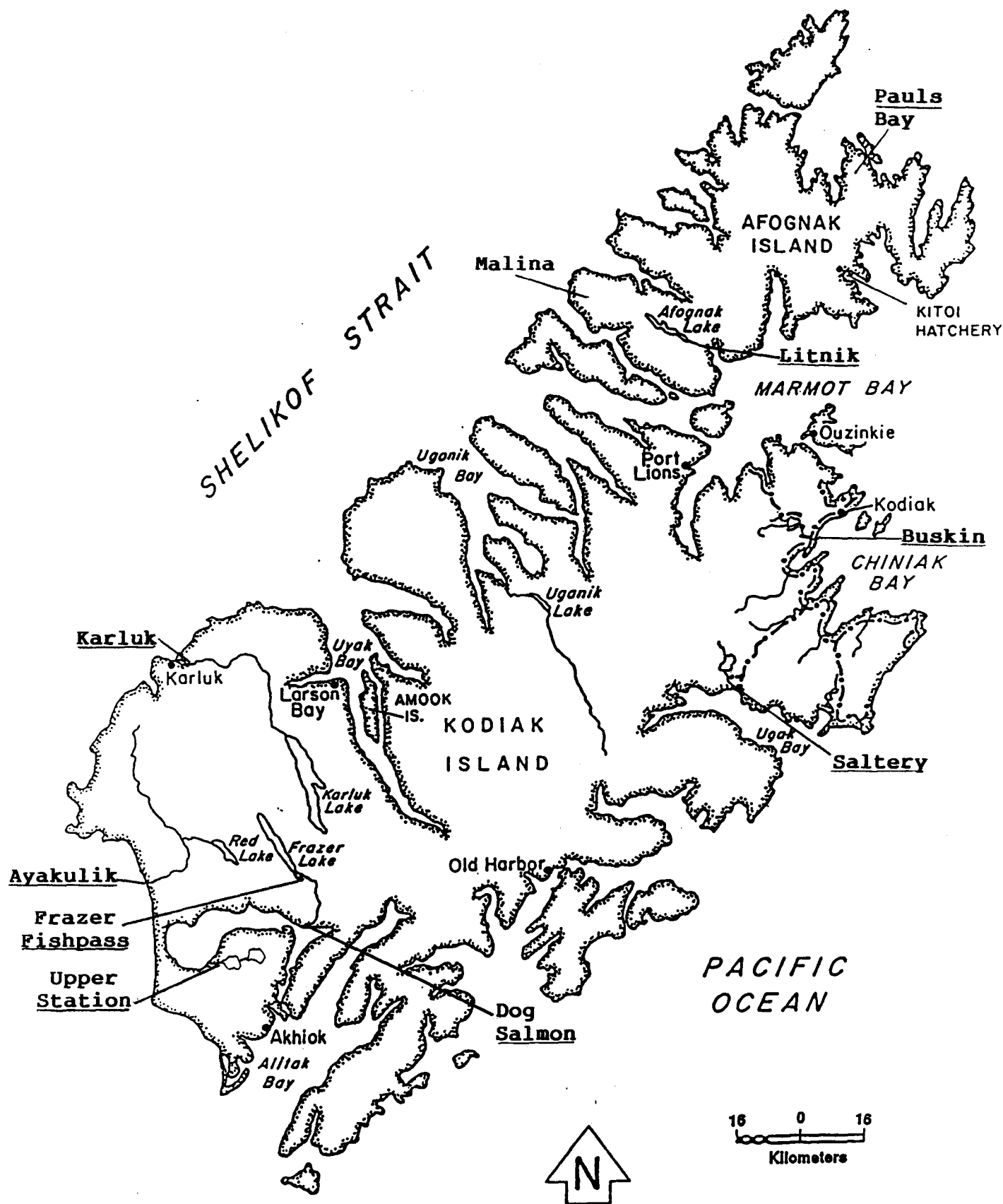


Figure 1. Location of salmon weirs in the Kodiak Management Area, 1993.

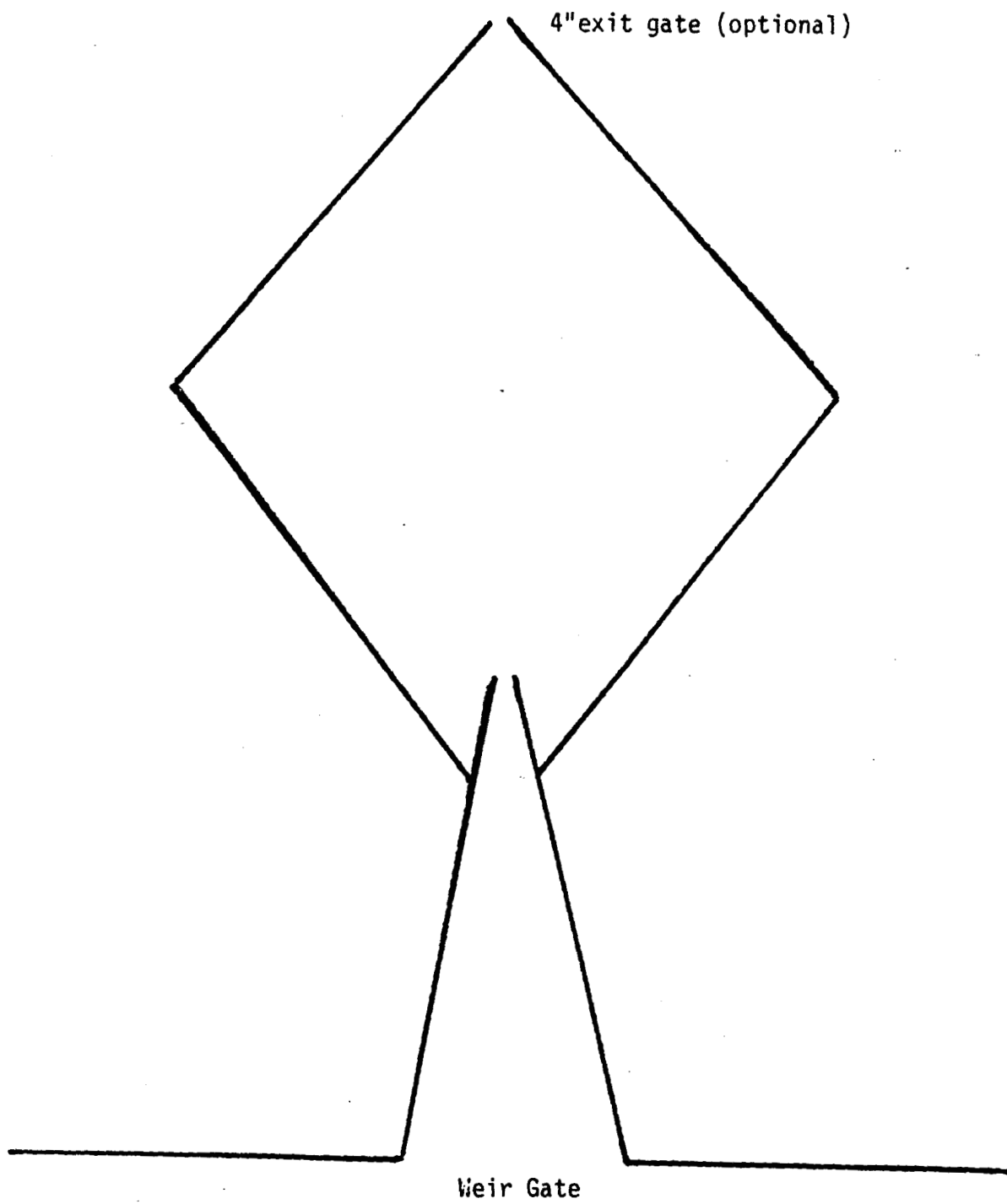


Figure 2. The "Scott" six panel salmon trap.

APPENDIX A

Procedure for Sampling Adult Salmon for age, length, and sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix A.1. Similar examples for sampling chinook and coho salmon are shown in Appendix A.2.

Complete each section of the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:

Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:

The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye and chum scale samples will have only 1 gum card per AWL form as shown in Appendix A.1. Coho and chinook samples will use up to four gum cards per AWL form as shown in Appendix A.2.

Species:

Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:

Use appropriate digits for the date the fish are caught.

District:

List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):

List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:

Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:

List the appropriate code as shown on Appendix A.3.

Period:

List the period in which the fish were caught (Appendix A.4.).

Project and Gear:

Refer to the reverse side of the AWL form for the correct code.

Mesh:

Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:

Use (2) mid-eye to fork-of-tail. Refer to Appendix A.5.

of cards:

Mark 1 (each AWL form in individually numbered) when sampling sockeye, chum, coho, and chinook salmon.

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices A.1 and A.2.

Species:

Write out completely (i.e., chinook, sockeye, etc.).

Locality:

For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:

Transfer the appropriate digits from the AWL form.

Gear:

Write out completely.

Collector(s):

Record the last names of person(s) sampling.

Remarks:

Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:**A. GENERAL**

1. Place the fish on its right side to sample the left side.
2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.
3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix A.5.) Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy.
4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix A.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.
5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix A.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix A.7).
6. When sampling sockeye and chum salmon, repeat steps 1 through 4 for up to 40 fish on each AWL form.

7. When taking multiple scales per fish as with chinook and coho salmon, sample the "preferred scale" and scale #2 as shown in Appendix A.6. Scale #2 is one inch to the left of the "preferred scale," and is 2 rows above the lateral line. Mount the 2 scales from fish #1 over 1 and 11 on the gum card as shown in Appendix A.2. Continue to mount the 2 scales from fish #2 over 2 and 12, etc. If sampling 3 scales, mount the scales over #1, #11, #21, etc.
8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.**

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.
2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.
3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.

4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.
5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor.
6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.
7. If AWLs get wrinkled or splotted they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.
8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.
9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.
10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.
11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Species SOCKEYE Card No 001
 Locality AKALURA ESC.
 Stat. Code 257-30-302
 Sampling Date: Mo 08 Day 16 Year 91
 Gear: BEACH SEINE
 Collector(s): HICKS KAPLAN PEARSON
 Remarks: _____

18	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11
30	29	28	27	26	25	24	23	22	21
40	39	38	37	36	35	34	33	32	31

samples = HICKS, KAPLAN, PEARSON(R)

DESCRIPTION: SOCKEYE/AKALURA/ESC.

ADFG ADULT SALMON AGE-LENGTH
FORM VERSION 2.1

CARD: 001

SPECIES: 2

DAY: 16

MONTH: 08

YEAR: 91

DISTRICT: 257

SUBDISTRICT: 30

STREAM: 302

LOCATION: Akalura

PERIOD: 34

PROJECT: 3

GEAR: 2

MESH:

TYPE OF LENGTH MEASUREMENT: 2

NUMBER SCALES/FISH: 1

1 OF CARDS

SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
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DO NOT WRITE IN THIS MARGIN
 litho code
 229518

SPECIES

- 1 - Chinook (king)
- 2 - Sockeye (red)
- 3 - Coho (silver)
- 4 - Pink (humpy)
- 5 - Chum (dog)

PROJECT

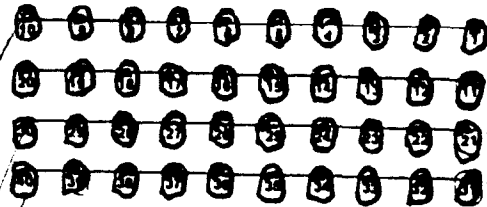
- 1 - Commercial catch
- 2 - Subsistence catch
- 3 - Escapement (tower, weir, sonar site, etc)
- 4 - Escapement - spawning grounds
- 5 - Test fishing
- 6 - Sport catch (marine)
- 7 - Sport catch (freshwater)

GEAR TYPE

- 8 - Trap
- 9 - Purse seine
- 10 - Beach seine
- 11 - Drift gillnet
- 12 - Set gillnet
- 13 - Troll
- 14 - Long line
- 15 - Otter trawl
- 16 - Fishwheel
- 17 - Pots
- 18 - Sport hook and line
- 19 - Herring purse seine
- 20 - Handpicked
- 21 - Dip net
- 22 - 16 Unassigned
- 23 - Beam trawl
- 24 - Shovel
- 25 - Warr
- 26 - 99 Unassigned

Species COHO Card No 001A
 Locality KARLUK ESC
 Stat Code 255-10-101-
 Sampling Date Mo 08 Day 29 Year 91
 Gear: WEIR / TRAP
 Collector(s): T. STACK, S. BROWN, J. FOX
 Remarks: 2 SCALES / FISH

card: 001A



DESCRIPTION: COHO / KARLUK / ESC
2 SCALES / FISH

SAMPLERS:
T. STACK - W
S. BROWN - P
J. FOX - R

ADF&G ADULT SALMON AGE LENGTH
 FORM VERSION 2.1

CARD:		SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
001A+B							
SPECIES: COHO							
DAY: 29							
MONTH: 08							
YEAR: 91							
DISTRICT: 255							
SUBDISTRICT: 10							
STREAM: 101							
LOCATION: 35							
PERIOD: - 35							
PROJECT: ESC							
GEAR: WEIR/TRAP							
MESH:							
TYPE OF LENGTH MEASUREMENT: 2							
NUMBER SCALES/FISH: 2							
# OF CARDS: 1							

DO NOT WRITE IN THIS MARGIN

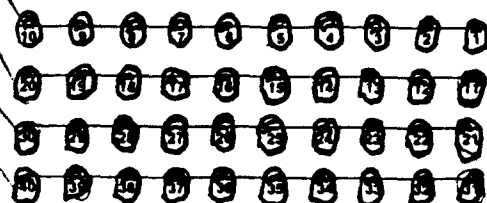
216854

litho code

NCS DOCUSCAN M820-17877 109 A5200

Species COHO Card No 001B
 Locality KARLUK ESC
 Stat Code 255-10-101-
 Sampling Date Mo 08 Day 29 Year 91
 Gear: WEIR / TRAP
 Collector(s): T. STACK, S. BROWN, J. FOX
 Remarks: 2 SCALES / FISH

card: 001B



Appendix A.2. AWL and scale cards for sampling 2 scales per fish.

Appendix A.3. Assigned port and weir location codes.

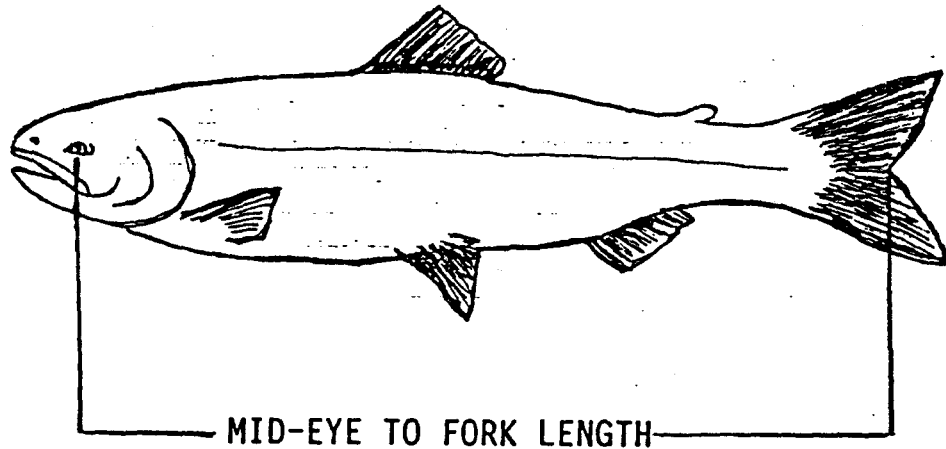
Port and Location Codes

030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix A.4. Periods and corresponding calendar dates, 1993.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Sep
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

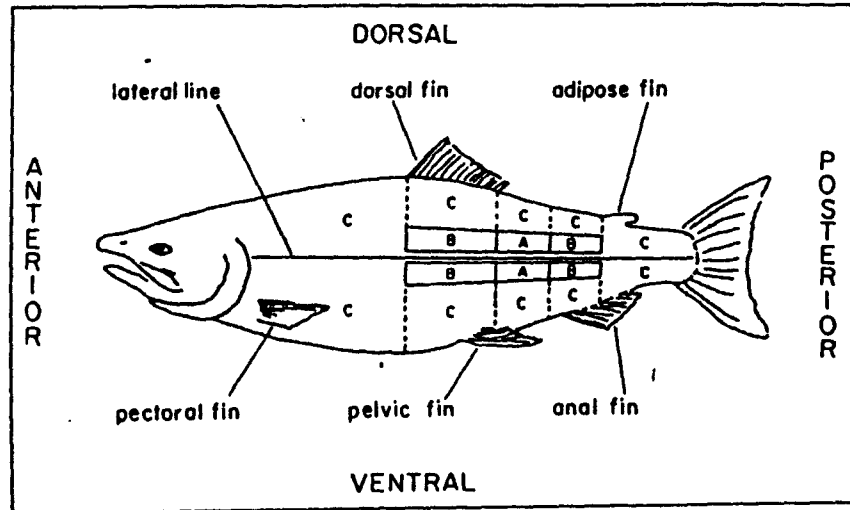
Appendix A.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

- 1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.
- 2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.
- 3) Flatten and spread the tail against the board with your right hand.
- 4) Read the mid-eye to fork length to the nearest millimeter.

Appendix A.6. Removal and mounting of the preferred scale.

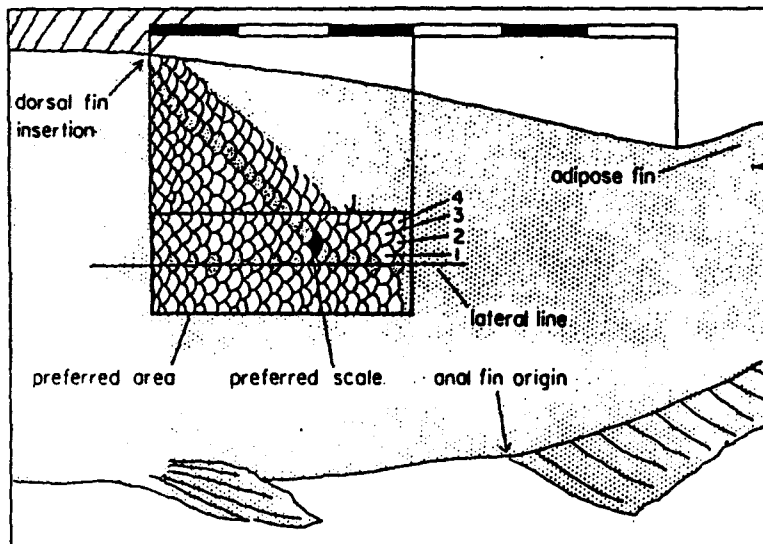


INPFC rated areas for scale removal.

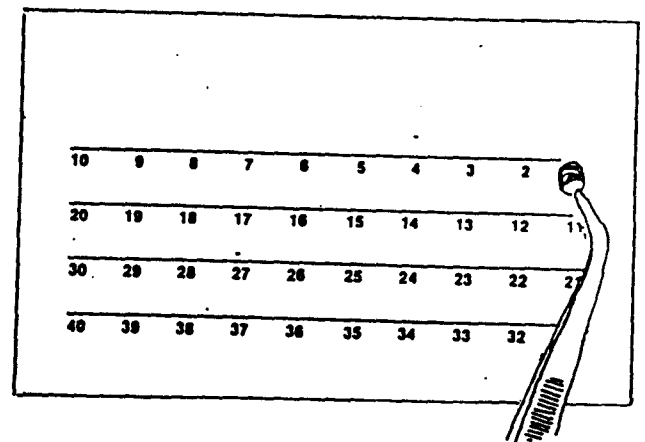
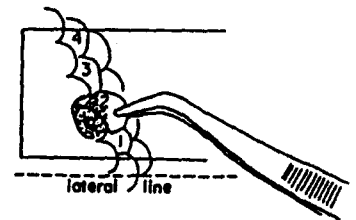
Area A is the preferred area. B is the second choice if there are no scales in area A.

C designates non preferred areas. If scales on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER

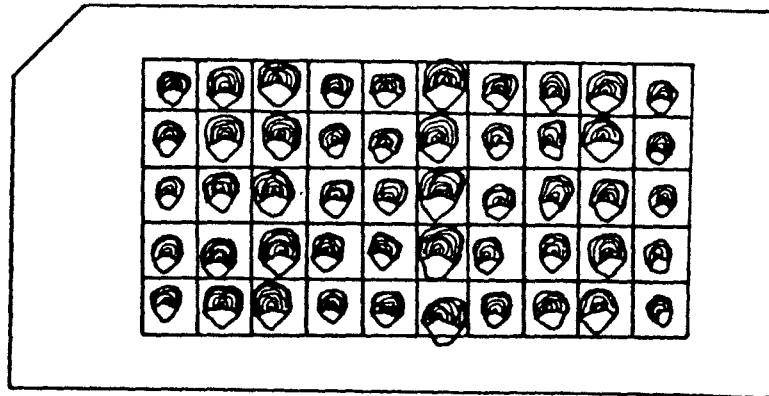


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

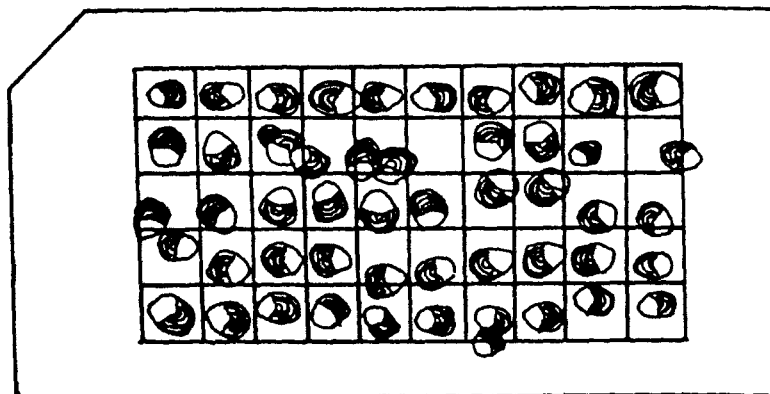


Place the scale directly over the number on the gummed card with the anterior portion (arches of the scale pointed toward the top of the card.

Appendix A.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

APPENDIX B

Kodiak Area Commercial Salmon Fishery Harvest Strategy, 1993

KODIAK AREA COMMERCIAL SALMON FISHERY

HARVEST STRATEGY, 1993

By:

**Dave Prokopowich
Kevin Brennan
Dennis Gretsch**

Regional Information Report¹ No. 4K93-21

**Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska 99615**

May 1993

¹The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

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INTRODUCTION

In 1993, commercial salmon fisheries in the Kodiak Management Area (Area K) will be managed according to a harvest strategy which emphasizes three criteria:

- (1) **To ensure that 1993 salmon escapement occurs in the proper magnitude and distribution so that the potential for maximum production of future returns is established.**

The results of ADF&G's 1993 management activities will directly affect the following future commercially targeted returns:

- 1995 pink salmon
- 1996 - 1997 coho salmon
- 1996 - 1998 chum salmon
- 1997, 1998, 1999 sockeye and chinook salmon

- (2) **To provide for orderly fisheries on the highest quality salmon by maximizing harvest opportunities during each fishing period.**

This requires a species oriented approach.

- For sockeye and coho salmon from major systems, management emphasizes the use of inseason weir escapement data to determine fishing time by geographical area.
- Fishing time on minor sockeye and coho systems without fish weirs is determined by ADF&G's perception of run strength for these systems.
- Managing pink and chum salmon returns emphasizes using preseason forecasts initially to determine fishing time and then adjusting fishing time inseason as the actual run strength becomes more apparent.

- (3) **To adhere to the biological and allocative requirements of all State Board of Fisheries (BOF) Management Plans, in order to ensure that traditional fishing opportunities for all commercial gear types and all user groups occur in a manner consistent with the criteria identified in (1) and (2).**

This harvest strategy is an overview of how ADF&G expects to manage the 1993 salmon fishery. Along with this overview, a basic management chronology (Figure 1) can be used as a guide to clarify why inseason adjustments in harvest strategy are needed, as dictated by species specific management requirements. For example, sockeye salmon management requires fishing time and areas open to fishing be strictly regulated by the sockeye salmon escapement information obtained from up to nine salmon weirs. Prorating fishing time for sockeye salmon solely on the basis of preseason expectations, other than for the June 9 commercial test fisheries, is not an acceptable method of managing Kodiak's sockeye salmon stocks. However, for pink salmon management, prorating fishing time based upon preseason expectations is mandatory for prosecuting Kodiak's pink salmon fishery successfully. This can be done with little chance of adverse effects on future production and is the most acceptable way of managing the harvest of Kodiak's relatively large

pink salmon returns. Chum and coho salmon require a blend of these two management approaches in that both species are initially harvested as bycatch in fisheries where fishing time is generally targeted on pink salmon. Targeted management and stock specific fisheries on chum and coho salmon requires proper run strength assessment before these fisheries can occur. This requires a combination of both weir and aerial escapement data and assessment of fish "buildups". This information can be used, along with inseason assessment of bycatch of these species, to determine if the returns can adequately support additional near terminal harvests.

HARVEST PROJECTIONS

Initial projections for the 1993 Kodiak commercial salmon fishery are for a harvest of approximately 25,294,500 salmon (Table 1). This includes harvests of approximately 21,000 chinook, 290,000 coho, and 1,200,000 chum salmon. Up to 15,000,000 wild stock and 6,500,000 Kitoi Bay hatchery produced pink salmon should also be harvested. This could be a record for an odd year pink salmon harvest; this good forecast is based on excellent pink fry overwinter survival and favorable weather during the spring of 1992 when fry were outmigrating into the nearshore ocean environment. Sockeye salmon harvested should only be near 2,200,000 fish. This is lower than the harvest of recent years. The relatively weak sockeye forecast is in part due to lower than average expected returns to the Ayakulik River and Frazer Lake systems. Both the early and late run sockeye fisheries are expected to harvest near 1.1 million sockeye salmon (Table 1).

In 1993, in addition to the pink salmon produced at the Kitoi Bay Hatchery, enhancement projects conducted by the Kodiak Regional Aquaculture Association (KRAA) and ADF&G's Fisheries Rehabilitation and Enhancement Division (FRED), should contribute to the common property fisheries of the Kodiak Area. Supplemental production may allow for up to 22,000 sockeye, 5,000 chum, and 11,200 coho salmon to be harvested (Table 2).

A good tool for illustrating the timing and magnitude of salmon harvests are projected harvest graphs (Appendix A.1 - A.3.). A curve can be drawn, based on the historical average cumulative salmon catch by date, that is scaled to the current preseason harvest projection. By keeping track of the actual salmon harvest by date, and plotting these on the graphs, a comparison of expected and actual return can be made. These graphs are used for planning purposes by both ADF&G and industry to identify if preseason management or operational strategies need to be modified inseason because of unexpected deviations in actual run strength.

FISHING PERIODS

All fishing periods will be by emergency order and will generally be based upon inseason assessment of actual run strength (Table 3).

Opening Times

All regular fishing periods will begin at 12:00 Noon and end at 9:00 P.M., except:

- The Cape Igvak fisheries will usually begin at 12:01 A.M. and end at 12:01 A.M. during the period of June 6 through July 25.
- The Inner Ayakulik Section fisheries will usually begin at approximately low tide. These will be daylight openings, and will be initiated by ADF&G "flare openings". When such openings occur, the opening time for the Outer Ayakulik Section may be adjusted to coincide with the Inner Ayakulik Section.
- Beginning on August 16, all fishing periods will end at 6:00 P.M. instead of 9:00 P.M.

Advance Notice for Each Fishing Period

- All advance notice time will be based upon the initial announcements being made on SSB frequency 4125 Khz, following the **6:00 P.M.** daily marine weather broadcasts.
- For the **Cape Igvak fishery**, the initial fishing period will have at least a **36 hour advance notice**. All subsequent fishing periods will have at least 18 hours advance notice, unless it is an extension of an ongoing fishing period.
- For the **June sockeye fisheries** in the Alitak, S.W. Kodiak, and N.W. Kodiak Districts, the **initial fishing periods** will have at least a **42 hour advance notice**; this includes the normal June 9 fishing period for the Alitak and N.W. Kodiak Districts and the approximate June 14 fishing period for the N.W. Kodiak District.
- All subsequent fishing periods for the Kodiak Area prior to July 6 will have at least 18 hours advance notice.
- For the initial pink/chum salmon fisheries, at least 42 hours advance notice will be provided, with the fishery starting at 12:00 noon on July 6.
- All subsequent fishing periods for the Kodiak Area after the July 6 fishing period will have at least 18 hours advance notice.
- All extensions in fishing time from a previously announced fishing period will have at least 3 hours advance notice.

In Period Closures

- During the period July 6 through July 25 in period closures of "Seaward Zones" designated in the North Shelikof Strait Sockeye Salmon Management Plan may occur. Fishers who are fishing in management units covered by this plan are advised that in

period closures of "Seaward Zones" are possible and that such closures will be announced on SSB frequency 4125 at 8:00 A.M., 10:00 A.M., 2:00 P.M., or 6:00 P.M. with the effective closure time occurring three hours following the initial announcement time.

Length of Fishing Periods

Sockeye Salmon

In general, each fishing period targeting on early and late sockeye salmon runs to all major systems will be dependent upon weir escapement counts. This will also apply to those minor "weired" systems targeted by the commercial fishery.

The exceptions to this will be the normal June 9 commercial test fisheries in the Alitak Bay and N.W. Kodiak Districts. The first period will extend from 12:00 Noon Wednesday June 9 through 9:00 P.M. Thursday June 10, a 33 hour period. A second 33 hour commercial test fishery will occur in the N.W. Kodiak District on approximately June 14 depending upon when this fishery can be coordinated with other terminal sockeye fisheries in order to spread the fishing effort. Additional fishing time in the Alitak Bay District will depend on the results of the June 9 commercial test fishery, the ADF&G test fishery, weir escapements and positive buildup trends (see Alitak Bay District Management Plan).

In conjunction with this second commercial test fishing period in the N.W. Kodiak District, will be a potential 33 hour fishing period for healthy minor sockeye salmon systems (Afognak Lake, Saltery, etc.). Specific management units (sections) open for this fishery will be dependent upon the strength of the runs associated with these units. The E.O. announcement for this opening will specify which sections are to be opened.

Fishing periods in the Cape Igvak Section will continue to be in increments of 24 hours running from 12:01 A.M. to 12:01 A.M.. Fishing time will be dependent upon an evaluation of the Chignik System sockeye salmon run, the predominant contributing stock harvested in this section. A review of the Cape Igvak management plan listed in this document should clarify the biological and allocative requirements of this plan. For the 1993 season, fishing time will initially be allocated in the Cape Igvak Section based upon the criteria listed in paragraph (c) of the plan.

For most late run sockeye salmon stocks, a portion of the harvestable surplus is commonly taken as bycatch during targeted pink salmon fishing periods. Consequently, a "blended" management strategy is needed to insure minimum escapements are achieved by species with desired escapement requirements not being exceeded. The Westside Kodiak Management Plan provides an overview of which salmon stocks and time periods are targeted for management.

Pink Salmon

The total 1993 projected pink salmon harvest of 21.6 million fish, which includes Kitoi Bay Hatchery's projected contribution of 6.5 million pinks, represents a potential record high harvest. Overall, preemergent fry densities from the 1991 brood year were the highest on record for an odd year return. Mild spring weather conditions, combined with the overall high live fry densities, are the main factors which resulted in the 1993 pink salmon run being forecast at near record levels. It should be noted that during the previous three years (1990, 1991, 1992) pink salmon returned to Kodiak Area streams at less than forecasted levels. For the 1992 return, poor early marine conditions may have been the main factor for the less than expected return. In 1990 and 1991 there were very low adult average weights, which points to poor ocean rearing conditions. If similar marine conditions exist that may have affected the 1990 and 1991 returns, the 1993 pink salmon run may be less than projected. For planning purposes the actual harvest could approach the lower end of the forecast range of 15 million pink salmon, and may not exceed the point estimate of 21.6 million pink salmon.

The 1993 harvest strategy for pink salmon will emphasize the three management criteria identified in the introduction of this document.

In consideration of the forecasted strength of the 1993 pink return and the expected strong early production associated with odd year returns, **the 1993 pattern of fishing periods for those management units where pink salmon are the targeted management species is expected to vary in fishing time from 4-1/2 days per week up to 7 days per week from July 6 through approximately August 25.**

Listed below are projected fishing period scenarios which can be used for planning purposes by both ADF&G and industry. **Changes in these scenarios should be expected if significant deviations in the actual pink salmon return occurs.** Less fishing time should be expected in management units where chum salmon are the targeted management species.

First Period: 4-1/2 days (105 hours) - 12:00 Noon July 6 through 9:00 P.M. July 10. In recent years this initial fishing period has varied between 2-1/2 to 4-1/2 days in duration. Due to the expected strong early production associated with an odd year return a longer initial fishing period is warranted. This period provides harvest data important for early run strength assessment for Area K's entire pink salmon run as well as for specific chum salmon stocks. No extensions in fishing time based on pink or chum salmon harvests would occur during this period. In consideration of the run out tides, closed waters will be increased in the Inner Uganik Bay Section beginning with this fishing period.

Second Period: 4-1/2 days (105 hours) - 12:00 Noon July 13 through 9:00 P.M. July 17. This second period will help ensure that early run pink salmon stocks and several major chum salmon stocks are adequately harvested per the stated management goals, and that at least minimum escapements are ensured. Assessment of run strength for both species will emphasize harvest data. No extensions in fishing time based on pink or chum salmon harvests would occur during this period.

Third Period: 4-1/2 days (105 hours) - 12:00 Noon July 20 through 9:00 P.M. July 24. This third period will occur following a two day closure, to allow an influx of pink and chum salmon into terminal areas to enhance the build-up of potential escapement fish. This is the first fishing period when the combination of harvest and early escapement/build-up information will provide the initial indications of actual run strength for major pink salmon fisheries. While no extensions in fishing time are expected during this period, the assessment results of this period have commonly resulted in reduced fishing time during the fourth period for years of weaker than expected pink salmon returns.

Fourth Period: 4-1/2 days (105 hours) - 12:00 Noon July 27 through 9:00 P.M. July 31. This fourth period is a very critical period in that the peak harvest dates and a fairly accurate assessment of total run strength should be evident by period's end. Extensions in fishing time commonly occur off of this period during years when the pink and chum salmon returns are equal to or stronger than expected. The initial pink salmon opening for the Kitoy Bay Section should occur at the beginning of this fishing period.

Fifth Period: 4-1/2 days (105 hours) - 12:00 Noon August 3 through 9:00 P.M. August 7. This fifth period should yield the peak harvest date and should be the peak harvest period in 1993, provided normal run timing occurs. If preseason expectations appear valid, extensions in fishing time could occur in portions of the management area. This period commonly yields the first significant announcement of differential fishing time by management unit as heavy production areas are targeted for extensions, while moderate or lower production areas are not. Extensions in fishing time are not expected for management units located in the N.W. Kodiak District.

Sixth Period: 4-1/2 days (105 hours) - 12:00 Noon August 10 through 9:00 P.M. August 14. This sixth period should be the first postpeak period and is important from the standpoint that returns to major late production systems should be evident by period's end. Also this is a critical period for considering expansions in closed water sanctuaries to enhance escapement levels, and to make a final evaluation of run strength to determine if further reductions in fishing time are needed for the remaining periods to ensure adequate escapement; a strategy for "topping off" escapement for all systems stems from this period.

Seventh Period: 4-1/2 days (102 hours) - 12:00 Noon August 17 through 6:00 P.M. August 21. This seventh period is when a blended, multi-species management approach is needed for those sections where pink salmon were the targeted species for the previous six periods. Emphasis will still be on harvest of excess good quality pink salmon and on achieving at least minimum pink escapements where applicable. However major concern will be directed toward the run strength of late run sockeye and chum salmon.

Eighth Period: 3-1/2 days (78 hours) - 12:00 Noon August 24 through 6:00 P.M. August 27. This eighth period will be primarily a cleanup period for most pink salmon stocks; all escapement requirements should be mostly assured and all excess pink salmon of acceptable quality should be available for harvest in near terminal areas where applicable. Again, this period will require a major emphasis on multi-species management; it is a critical management period for late run sockeye and chum salmon stocks as well as early run coho salmon stocks.

Chum and Coho Salmon

A large portion of the 1993 Kodiak chum and coho salmon harvest will occur as bycatch in nonterminal locations during fishing periods having fishing time associated with major pink salmon fisheries. System specific chum and coho salmon fisheries which occur during the pink salmon fishery will commonly result in pertinent management units having less fishing time than management units targeting primarily pink salmon stocks. This approach emphasizes the use of more terminally located management units for targeted chum and coho salmon management (i.e. Inner Kukak Section, Zachar Bay Section, Kizhuyak Section, etc.)

EMERGENCY ORDER INSEASON ANNOUNCEMENTS ("GETTING THE WORD")

Fishing period announcements may not always be predictable because the fishery is managed on data evaluation which is compiled daily. Data used to make fishery decisions includes (1) escapements via weir counts and/or aerial surveys, (2) harvest trends (total catch and catch per unit effort) and (3) information on fish buildups.

Once enough information has been collected to determine fishing time needed to harvest surplus fish an emergency order and a fishery announcement is "immediately" issued in the following manner:

- 1) A news release is constructed detailing:
 - a) The date, time, and number of the emergency order announcement.
 - b) The length of the fishing period.
 - c) The opening and closing times and dates of the fishing period.
 - d) The areas open to fishing.
 - e) The areas closed to fishing (those sections not listed as being open).
 - f) The location of "closed water" marker adjustments.
 - g) Justification for the opening/closing
- 2) The news release is posted at the entrance of the Kodiak ADF&G office.
- 3) Copies of the news release are made available at the Kodiak office. For after hours availability, copies are stored at the main entrance.
- 4) The news release is recorded on a 24 hour recorded message phone (Number 486-4559).
- 5) The news release is made available to three local radio stations (K.V.O.K., K.M.X.T., and K.G.T.L.) to be played by these stations at predesignated times during the day.
- 6) The news release is announced over SSB channel 4125 Khz following the marine weather broadcasts. Commonly, the first reading of a news release occurs after the 6:00 P.M. weather, but occasionally the initial reading comes after the 8:00 A.M. weather broadcast.

- 7) The news release is distributed to all processors either by hand, verbally on the telephone, by tele-fax, or through the ADF&G recorded message phone; this information is then passed along to their respective tenders.
- 8) Information on the most current news release or emergency order can also be obtained by calling the Kodiak ADF&G office during working hours, or by calling Dave Prokopowich (486-6007) or Kevin Brennan (486-6475) after working hours or on weekends.
- 9) Copies of emergency orders are mailed to a current listing of required and interested recipients.
- 10) Many fishers, ADF&G vessels and camps, and Fish and Wildlife Protection vessels use a small tape recorder to document the exact wording of each announcement as broadcast. This is a prudent thing to do when considering the complicated nature of each announcement.

NEW REGULATIONS

There are several new regulations for the Kodiak commercial salmon fishery in 1993, as adopted by the Alaska State Board of Fisheries (BOF) at a meeting held in Kodiak during January 1993. Following is a brief synopsis of the new regulations; a complete copy of all the new regulations is currently available at the Fish and Game office. In addition to the regulatory changes listed below, the BOF made some modifications of existing management plans and passed into regulation two additional plans (see section MANAGEMENT PLANS). The new 1993 Commercial Salmon Fishing Regulations book for the Kodiak Area may be available soon.

5AAC 18.200. Description of Districts

Southeast Afognak Section

In past regulations a description of the Southeast Afognak Section was accidentally omitted from the Description of Districts. A legal language was included this year which specifies the boundaries of this section as the latitude of Cape Kostromitinof on the north, and a line from Head Point on Afognak Island to Dolphin Point and the latitude of Dolphin Point on the south.

Spiridon Bay and Central Section

The boundary between these sections was moved slightly to the east to accommodate a traditional gillnet site. The boundary in Spiridon Bay had been the longitude of Hook Point, and has now moved slightly further into the bay, to 153°46'20" W. longitude.

Outer Karluk Section

The southern boundary of this section is the latitude of Pafco Point, however this latitude was incorrectly listed in the regulation book. The correct latitude is 56°36'20" N. latitude.

5AAC 18.201. Seaward Boundary of District (Three Mile Limit)

According to Title 50, part 674 of the Code of Federal Regulations it is unlawful to engage in commercial fishing for salmon in waters seaward of the state (the "three mile limit") territorial sea boundary west of Cape Suckling. During the 1993 Board of Fisheries meeting held in Kodiak, board members passed regulatory language to clarify the prohibition of salmon fishing outside the territorial sea boundary, stating that the seaward boundary of all districts in the Kodiak Area will be the territorial sea boundary as shown on NOAA charts 16580 and 16568.

5AAC 18.320. Fishing Periods

To allow for the orderly harvest of sockeye salmon returning from the Spiridon Lake stocking project a special harvest area has been designated in the normally closed portion of the Spiridon Bay Section. Language was added to this section of the regulations to specify that openings will be by emergency order only, will only occur during daylight hours, and be a maximum of 6 hours in duration. A management plan for this fishery was also approved by the BOF. Due to low numbers of sockeye salmon expected to return to Spiridon this year (4,000), and projected fishing time of 4 1/2 days per week during the pink salmon fishery, no fishing time is expected to be necessary in the special harvest area this year.

5AAC 18.330. Gear

In the last regulation book an oversight in editing led to some confusion about the type of gear which could operate in the Alitak Bay District after September 4. The wording mistakenly allowed set gillnet gear to fish in the Cape Alitak and Humpy/Deadman Sections. This was corrected to say that after September 4, salmon may be taken by seine gear in the entire Alitak Bay District.

5AAC 18.331. Gillnet Specifications and Operation

Set Gillnet Attachment

A regulation which would have modified the attachment point of set gillnets in the Moser-Olga Bay Section was passed by the BOF, but the Department of Law subsequently disapproved the regulation for filing. The attachment for gillnets in the Kodiak Area will remain as has been listed in 5AAC 18.331.

5AAC 18.332. Seine Specifications and Operation

Beach Seine Operation

Language which clarifies the manner in which a beach seine is operated in the Kodiak Area was passed into regulation by the BOF. A beach seine must be set from, and hauled back to, a beach,

or to a vessel anchored to a beach. For beach seines only the shoreward end of the seine or lead may be anchored, and an additional anchor may be used to attached the vessel to a beach only while retrieving the beach seine. Also it is defined that any ring, strap, purse or tow line may only be attached to the corkline of beach seines. As always, one end of the beach seine must remain on the beach above the surface of the water at all times during the set, and a beach seine has ceased fishing only when all the leadline is out of the water.

Seine Leads

Minimum mesh size is seven (7) inches. Language was passed which states that it is illegal to use overlapping panels of web in a seine lead.

5AAC 18.337. Purse Seine Practice Sets

The BOF has legalized the practice of purse seine practice sets. However to minimize potential enforcement problems the time period for making practice sets was limited to June 1 through June 7, during daylight hours only. Similarly, the locations where practice sets can be made is limited to four (4) areas: inside Lazy Bay, inside Larsen Bay, within 1/2 mile of the Sealand dock in the city of Kodiak, and within 1/2 mile of the entrance to the boat harbor in the city of Old Harbor.

5AAC 18.350 Closed Waters

Dry Bay

In order to provide additional protection for local stocks the closed water sanctuary in Dry Bay has been changed to all water west of 155°44' W. long. This was implemented by emergency order during the past two seasons.

Karluk Closed Water Sanctuary

Due to the problems encountered in the past with the closed water sanctuary seaward of Karluk Lagoon, as currently described in regulation 5AAC 18.350., the following closed water sanctuary will be in effect, by emergency order, near the entrance to Karluk Lagoon, stream #255-101 (Figure 2):

5AAC 18.350 CLOSED WATERS (2) Southwest Kodiak District

(E) That portion of the Southwest Kodiak District (off of the entrance to Karluk Lagoon (stream #255-101)) enclosed by a line from 57°34'28" N. lat., 154°28'18" W. long. to 57°34'32" N. lat., 154°26'42" W. long. (NOAA Chart #16598).

Buskin River Closed Water Sanctuary

The stream mouth of the Buskin River (stream #259-211) has moved considerably over the past several years. The markers which were present were not providing adequate protection to salmon migrating into the stream. The north shore marker has been moved and an offshore point is

designated to aid in triangulation of the closed water area. The offshore point is at the reef directly east of the spit, and may be marked with a buoy. The location of the closed water will be described in the first salmon emergency order as follows (Figure 3):

5AAC 18.350 CLOSED WATERS (6) Northeast Kodiak District

- (E) Buskin River: all waters inside of a line running from a marker on the bluff north of the mouth of the Buskin River at approximately 57°45'48" N. lat., 152°28'23" W. long. to a point offshore at 57°45'21" N. lat., 152°28'09" W. long. to a marker located onshore south of the river mouth at approximately 57°45'09" N. lat., 152°28'39" W. long. (NOAA Chart #16595)

5AAC 18.355. Reporting Requirements

Beginning in 1993 commercial fishers must report on an ADF&G Fish Ticket salmon kept for personal use. New fish tickets will have a specific area for reporting salmon kept for personal use, but if an old style ticket is used the number of salmon, by species, taken for personal use **must** be recorded on the ticket.

MISCELLANEOUS REGULATORY CLARIFICATIONS

Closed Water Adjustments

As a result of conflicting interpretations of Alaska Statute 16.05.785, failure to remove markers, there will be no inseason adjustments of closed waters unless ADF&G personnel will be able to remove old markers and install new markers or unless inseason adjustments of closed waters are made to a specific stream terminus. All adjustments to closed waters listed in 5AAC 18.350 will be made by emergency order.

Closed Water Sanctuaries

In areas where ADF&G has deployed regulatory markers to establish waters closed to fishing, a straight line closure is in effect provided that no portion of that line is less than 500 yards from the seaward extremities of the exposed tideland banks which designates the stream mouth. Consequently, common closed water configurations will be areas of various shapes, depending upon the nature of each individual stream mouth extending between the two regulatory markers. In areas where ADF&G has deployed regulatory markers to establish waters closed to fishing in bays a straight line closure is in effect.

In the Mainland District, ADF&G is expanding its stream marker program. Fishers participating in salmon fisheries located in the Mainland District should be aware that closed water sanctuaries may be larger in some areas due to the placement of markers, to protect "buildup" fish during low tides.

Boundary Determinations

When determining the location of a particular district or section boundary, or any inseason emergency order boundary, the latitude and longitude as plotted on a NOAA navigational chart, NAD 1927, approximate scale 1:80,000, will represent the correct boundary locations. Boundaries plotted on NOAA navigational charts using NAD 1983 may not correspond to the correct locations. Latitude and longitude as determined by Loran or Global Positioning System (GPS) bearings may represent incorrect boundary locations. District and Section boundaries are depicted on the current Kodiak salmon statistical area chart (available at Kodiak ADF&G office).

Section Boundaries

The Raspberry Straits Section is not part of the Southwest Afognak Section.

Purse Seine Leads

Minimum mesh size is seven (7) inches. Double panels of web overlapped in the lead will not be legal.

Set Gillnets - Operation of Gear

Leads

"Seine webbing" used as a lead for set gillnets is not intended to "gill salmon". Set gillnet leads which have similar mesh size and web construction to the actual set gillnet gear will not be considered legal gear.

Operation of Set Gillnets

Set gillnets must be operated in substantially a straight line, except that no more than 25 fathoms of a set gillnet may be used as a hook. A hook may be used in any configuration. When a set gillnet is being operated primarily as a "hook in any configuration" it will be considered illegal to actively operate that gillnet as a purse or beach seine (such as "round hauling").

FISH TICKETS

A reminder to all fishers to check the statistical area recorded on each of your fish tickets. It is required that the correct harvest location(s) be shown on each ticket and it is the responsibility of each fisher to ensure tender operators or the cannery personnel record the correct harvest location on each ticket. This information is extremely useful in evaluating inseason harvest levels, stock contribution, and effort distribution.

Seiners

Please provide estimates of harvest by area to tender operators. For example "1/3 of my reds were from Cape Alitak (257-20) and the rest were from Red River (256-20). The rest of my fish were 1/2 and 1/2 from each of these areas". Prior to signing your tickets, check to make sure the proper harvest information by **STATISTICAL AREA** has been entered.

Of particular importance will be the accurate recording of the harvest from that portion of the Shelikof Strait regulated by the Shelikof Strait sockeye salmon management plan. In order to provide an accurate accounting of sockeye salmon harvests in this area, ADF&G and Fish and Wildlife Protection will conduct extra monitoring of harvest activity and tendering operations in this area during the July 6 to July 25 time period of this plan.

Gillnetters

Because of the fixed nature of this gear, each permit holder's reporting area (statistical area) should be consistent between landings. However, in the event that you become "exploratory" with your nets and move into a new statistical area, please provide the tender operator with that information. Prior to signing your tickets, ensure that the proper harvest information by **STATISTICAL AREA** has been entered.

MANAGEMENT PLANS

Currently there are seven (7) Board of Fisheries approved management plans which provide guidance to ADF&G for specific portions of the Kodiak Management Area. Each management plan affects several management units (Table 4) through part or all of the salmon fishing season. As with any good plan, the test of time and a continued review process will determine its effectiveness at accomplishing the desired biological and allocative goals. The 1993 season will provide additional opportunities to evaluate the merits of these Board approved plans. One of these, the Westside Kodiak Management Plan, covers the greatest geographical area and affects more user groups and gear types than any other plan. In contrast, the Crescent Lake Plan is associated with a relatively small coho enhancement project which impacts the subsistence fishery in the vicinity of Port Lions, and so a plan was needed to clarify coho fishery priorities for that area.

Proper implementation of these plans in 1993 will require a major communication effort between ADF&G and the industry. As with any of these plans, if there is a need for plan clarification, all inquiries, suggestions, and concerns are encouraged to be directed to ADF&G, Kodiak. A discussion of each plan follows.

Cape Igvak

The Cape Igvak Management Plan covers the time period from June 5 through July 25 for fishing activity in the Cape Igvak Section of the Mainland District (Table 5). This plan has been in effect since 1978 and allocates a percentage of the available Chignik sockeye salmon for harvesting (approximately 15%) to Kodiak permit holders when specific biological and harvest criteria are met in Chignik. Fishing time after July 25 in the Cape Igvak Section will be targeted toward pink, chum and coho salmon bound to spawning streams in the Cape Igvak Section and in the Wide Bay Section.

The 1993 forecast for Chignik sockeye salmon runs indicate that early production should be above average, and that late production should continue at or above average.

A detailed description of the Cape Igvak Management plan is listed in the regulation book under 5AAC 18.360.

Alitak Bay District

This plan covers the entire commercial salmon fishing season, and identifies the primary management species by management unit throughout the season (Table 6). The plan affects the sockeye salmon stocks returning to the Frazer, Upper Station, and Akalura systems, and the pink and coho salmon stocks returning to Dog Salmon, Upper Station, Akalura, Humpy Cove, Deadman, Horse Marine, and Silver Salmon systems. This plan has been in effect since 1988.

The management chronology for Olga Bay stocks identifies the targeted management stocks by approximate time period. In situations where two or more targeted stocks overlap in run timing a "blended" management approach will occur, whereby adequate fishing time will be provided to ensure desired escapement goals are not exceeded for the more dominant stock(s) yet that the minimum escapement goals for the less dominant stock(s) are achieved. As decreed by the Board of Fisheries, fishing time directed on these stocks will occur simultaneously in the traditional management units for harvesting these stocks, namely the Cape Alitak Section and the Moser-Olga Bay Section. Management for these stocks will emphasize an aggressive strategy to contain the harvest to these traditional harvest units; this strategy also applies to the remainder of the stocks in the Alitak Bay District.

The regulatory wording for implementing this management plan appears in the 1993 Commercial Finfish Regulation Book under 5AAC 18.361. Dates listed in the plan are approximate and may vary with changes in run timing; an exception is the June 9 commercial test fishery, which is a firm date. The specifics for managing the 1993 returns need to consider the expected magnitude of the targeted stocks returning to the Olga Bay systems. The sockeye salmon returns to Alitak are expected to yield relatively strong sockeye salmon production from the early run Frazer system and the late run Upper Station system. In conjunction with the late run sockeye production, a relatively strong return of pink salmon to the Dog Salmon river is expected to be available to the fishery. Because of the early timing of Dog Salmon River pink return harvestable surplus for both stocks should be taken in the traditional Cape Alitak, and Moser/Olga Bay

Sections. Fishing time in the upper Olga Bay sections is not expected in 1993 unless the Upper Station return is much weaker than forecasted.

Some specific points to stress this year are:

- The approximate June 12 through June 24 period is identified as an aggressive management time for Frazer sockeye salmon.
- To maintain equitable and orderly harvest opportunities for all gear types, and to insure that escapement requirements are achieved for the 1993 season, the minimum escapement goal for Frazer sockeye salmon (140,000) will be targeted.
- The minimum pink salmon escapement requirement for the Dog Salmon system is 60,000 fish and the desired goal is 180,000 pink salmon.
- In the event that fishing time is required in Upper Olga Bay management units, minimum advance notice will be as identified.
- Sockeye returning to Akalura will be aggressively managed in the Inner Akalura Section, to insure the sockeye escapement does not exceed 60,000 fish.

Westside Kodiak

The Board of Fisheries, at their December 1989 meeting in Kodiak, adopted into regulation this management plan which identifies the management chronology for major Westside Kodiak salmon stocks (Table 7).

The goal of this Management Plan is to achieve escapement and harvest objectives of sockeye salmon returning to the Karluk, Ayakulik, and other Westside minor systems, and of pink, chum, and coho salmon returning to systems in the Southwest Afognak, Central, North Cape, Anton Larsen Bay, Sheratin Bay, Kizhuyak Bay, Terror Bay, Inner Uganik Bay, Spiridon Bay, Zachar Bay, Uyak Bay, Outer Karluk, Inner Karluk, Sturgeon Bay, Halibut Bay, Outer Ayakulik and Inner Ayakulik Sections. The intent of the Board is to insure that salmon bound to these systems be harvested to the extent possible by the traditional fisheries located in all 17 sections. The plan directs the department to manage the Northwest Kodiak and the Southwest Kodiak Districts and the Southwest Afognak Section in accordance with the guidelines set out in this plan.

This plan was submitted as a proposed regulation to the Board of Fisheries by the Kodiak Management Staff in order to allow industry the opportunity to comment on existing harvest strategies and to clarify their intent. Frequently, Kodiak fishers had expressed concerns over how the department will manage the Westside management units (sections) into the 1990's, when local sockeye stocks are projected to be near maximum production, since this will affect the traditional harvest opportunities between fixed and mobile gear. The annual harvest strategy has traditionally invoked a "blend" of fishing time between the 17 management units covered by this plan. At times this "blend" has not been totally understood by industry and has resulted in enough allocative uneasiness that future management stability could be jeopardized. Guidelines for this "blend" needed to occur in regulatory form to specifically identify inseason harvest strategy and

to dispel any concern and confusion. Again, the previous regulatory structure did not provide the information needed by industry to evaluate inseason management decisions which affect allocation concerns of the three gear types affected by this plan.

This management plan reflects the realization of long term management goals and identifies current management practices both of which were initially implemented in 1971. The basis for these goals and practices was primarily to rebuild depleted Karluk and depressed Ayakulik sockeye salmon stocks. This plan provides a predictable management framework for these rebuilt stocks, as well as major pink, chum and coho salmon stocks of westside Kodiak, and helps to stabilize fishing opportunities between the three gear types on the highest quality fish in these districts and sections.

The regulatory wording of this plan appears in the 1993 Commercial Finfish Regulation Book under 5AAC 18.362.

North Shelikof Strait Sockeye Salmon

The Board of Fisheries in December 1989 created this management plan in response to concern that the fishing patterns and quantities of sockeye harvested by Area K seiners in 1988 represented the onset of an expansion of the interception of Cook Inlet bound sockeye in Kodiak Area waters. This plan was meant to contain this interception to not exceed estimated historical interception levels yet still provide for traditional opportunities to harvest high quality pink and chum salmon from local stocks. **The major impact of this plan was to create "sockeye harvest caps" for that portion of the North Shelikof which encompasses eight (8) management units. After these sockeye harvest caps are met, commercial salmon fishing is restricted in these 8 management units to waters inside of a line drawn cape to cape.**

During the January 1993 Board of Fisheries meeting in Kodiak, a modification of the management plan was made to allow the traditional near shore seine fisheries of the Southwest Afognak Section to continue, in the event of the sockeye harvest cap being exceeded. A 1/2 mile corridor along the capes was removed from the earlier definition of the "seaward zone" of the Southwest Afognak Section. After the harvest cap is met fishing will be restricted in waters outside of the 1/2 mile corridor (Figure 4).

The regulatory wording for this management plan is listed below and under 5AAC 18.363.

From July 6 through July 25 in the Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay, and Big River Sections of the Mainland District, and in the Shuyak Island and Northwest Afognak Sections of the Afognak District, the department shall manage the fishery as follows:

- **Management of the fishery must be based on local stocks;**
- **the fishery may remain open during normal fishing periods until the harvest exceeds 15,000 sockeye salmon;**

- when the harvest exceeds 15,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the shoreward zones, as described below:
- Dakavak Bay, Outer Kukak Bay, Inner Kukak Bay, Hallo Bay. and Big River Sections west of a line from Cape Douglas at 58°51'06" N. lat, 153°14'54" W. long, to a point at 58°42'40" N. lat, 153°26'18" W. long, to a point east of Swikshak River at 58°38'06" N. lat., 153°35'24" W. long., to Cape Chiniak at 58°31' N. lat., 153°54'21" W. long., to Cape Nukshak at 58°23'30" N. lat., 153°57' W. long., to Cape Ugyak at 58°16'36" N. lat., 154°06'03" W. long., to Cape Gull at 58°13' N. lat, 154°08'30" W. long., to Cape Kuliak at 58°08'11" N. lat., 154°12'34" W. long., to Cape Atushagvik at 58°05' N. lat., 154°18'48" W. long., to Cape Ilktugitak at 58°01'12" N. lat., 154°34'48" W. long to the southern entrance of Dakavak Bay at 58°01' N. lat., 154°43'30" W. long.
- Shuyak Island and Northwest Afognak Sections south and east of a line from Point Banks at 58°38' N. lat., 152°18'54" W. long., to Dark Island at 58°38'45" N. lat., 152°33'05" W. long., to Gull Island at 58°35'48" N. lat., 152°38'45" W. long., to the northern entrance of Big Bay at 58°34'06" N. lat., 152°40'12" W. long., to the western entrance of Blue Fox Bay at 58°27'41" N. lat., 152°43'42" W. long., to Black Cape at 58°24'33" N. lat., 152°53'09" W. long., to Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long.

From July 6 through July 25 in the Southwest Afognak Section of the Afognak District, the department shall manage the fishery as follows:

- management of the fishery must be based on local stocks;
- the fishery may remain open during normal fishing periods until the harvest exceeds 50,000 sockeye salmon;
- when the harvest exceeds 50,000 sockeye salmon, the department shall restrict the fishery by emergency order to waters of the Southwest Afognak Section Shoreward Zones east of a line from one-half nautical mile west of Cape Paramanof at 58°18'21" N. lat., 153°02'45" W. long., to one-half nautical mile west of Tanaak Cape at 58°15'36" N. lat., 153°06'09" W. long., to one-half nautical mile west of Steep Cape at 58°12'05" N. lat., 153°12'33" W. long., to one-half nautical mile west of a point at 5 at 58°08'25" N. lat., 153°18'52" W. long., to one-half nautical mile west of Raspberry Cape at 58°03'35" N. lat., 153°25'06" W., long.

All fishers and tender operators should familiarize themselves with the boundaries of these "seaward" and "shoreward" zones in each of these eight management units. Also, it will be the responsibility of both the permit holder and the tender operator to insure that fish tickets for fish harvested in the geographical area covered by this plan properly reflect the poundage and quantities of salmon by species taken in this geographical area. If there are lingering questions on this management plan feel free to contact ADF&G Kodiak staff.

Crescent Lake

As indicated earlier, this management plan is associated with a relatively small coho enhancement project which could impact the subsistence fishery in the vicinity of Port Lions. This plan clarifies the harvest priorities for coho salmon returning to the Settler Cove area near Port Lions. This plan was slightly modified by the Board of Fisheries, during the January 1993 meeting in Kodiak. Previously the plan allowed commercial harvest inside the breakwater at Port Lions only after September 16; this has now changed to September 10. In addition, the time period that this plan is in effect was changed from the entire salmon season to the time period July 15 through October 31. The wording of the regulations guiding this plan are listed below as well as in the 1993 Commercial Finfish Regulation Book under 5AAC 18.364.

5AAC 18.364. Crescent Lake Coho Salmon Management Plan.

- (a) From July 15 through October 31, the Department shall manage the commercial, sport, and subsistence fisheries in Settler Cove to provide for full utilization of the enhanced stock of coho salmon returning to Crescent Lake in accordance with the Crescent Lake Coho Salmon Management Plan in this section.
- (b) Sport and subsistence fisheries are allowed in all waters of Settler Cove consistent with 5AAC 64 and 5AAC 01.
- (c) The department may open, by emergency order, those waters of Settler Cove between the causeway and a line from the seaward end of the Port Lions breakwater to a department marker located directly across Settler Cove from the breakwater, to the commercial taking of salmon only as follows:
 - (1) the department may not allow the commercial taking of salmon before September 10; and
 - (2) before opening the fishery, the department shall determine that 500 or more coho salmon are available in Settler Cove for harvest.

Eastside Afognak

For the past several years the commercial salmon fisheries of the eastside of Afognak Island have been managed under an informal management plan formulated by Kodiak Area management biologists and Kitoi Bay hatchery managers. The Board of Fisheries, during the January 1993 meeting in Kodiak, adopted this plan into regulation. The goal of this plan is to achieve broodstock requirements for the hatchery and escapement requirements for local stocks, and specify the requirements for fishing time in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections (Table 8). The wording of the regulations guiding this plan are listed below as well as in the 1993 Commercial Finfish Regulation Book.

5AAC 18.365. Eastside Afognak Management Plan.

(a) The goal of the Eastside Afognak Management Plan is to achieve escapement and harvest objectives of sockeye, pink, coho, and chum salmon returning to natural spawning systems in the Southeast Afognak, Duck Bay, Izhut Bay, and Kitoi Bay Sections, and broodstock to Kitoi Bay hatchery. It is the intent of the board that salmon bound for these systems be harvested by the commercial fisheries located in these sections.

(b) The Southeast Afognak Section shall be managed on sockeye salmon returning to Afognak Lake during the period from June 9 through July 5. From July 6 through August 24, fishing opportunities will be based on pink salmon returning to major systems in Afognak, Kazakof (Danger), and Marka Bays. After August 24, fishing time will be dependent on coho salmon returning to this section.

(c) The Duck Bay Section shall be managed on early chum or sockeye salmon returns to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 24, fishing time will be based on returning mixed wild and hatchery pink salmon. After August 24, this section shall be managed on local coho salmon runs.

(d) The Izhut Bay Section shall be managed on the early chum or sockeye salmon returning to Kitoi Bay hatchery during the period June 9 through July 18. From July 19 through August 1, this section may remain closed to fishing to assure that pink salmon cost recovery goals are achieved at Kitoi Bay hatchery. If hatchery cost recovery harvests are not required, fishing time in this section will depend on returning wild and hatchery pink salmon from July 19 through August 24. After August 24, fishing time will be dependent on returns of local coho salmon and late hatchery sockeye salmon runs.

(e) The Kitoi Bay Section shall be managed on early run chum or sockeye salmon returning to the Kitoi Bay hatchery, from June 9 through July 20. From July 3 through July 3 through July 20, fishing opportunities will not occur until chum salmon broodstock requirements for the hatchery are assured. After July 20 through August 20, this section will be managed for pink salmon cost recovery and broodstock requirements. If there is no pink salmon cost recovery, the section may be managed to harvest pink salmon that exceed broodstock needs. After August 20, fishing opportunities may be provided to harvest returning late sockeye and coho that exceed broodstock needs.

Spiridon Bay Sockeye Salmon

The Kodiak Regional Aquaculture Association, in conjunction with ADF&G, has developed a supplemental run of sockeye salmon in Spiridon Bay. Sockeye smolt are stocked in Spiridon Lake to rear and then released into Spiridon Bay. Because of the steep topography of the creek leading to the lake the returning sockeye can not ascend to naturally spawn. All returning sockeye are intended for common property fisheries. ADF&G, KRAA, and the U.S. Fish and Wildlife Service developed a management plan which attempts to fully utilize these salmon while protecting local stocks. This management plan was adopted into regulation by the Board of Fisheries at the January 1993 meeting in Kodiak. The plan identifies a Special Harvest Area

inside the normally closed waters area of the Spiridon Bay Section (Figure 5). Openings shall be of short duration, no more than 6 hours, during daylight hours only, and will begin with a flare launched by ADF&G. The only legal gear type is seine. The harvest area may be adjusted or the harvest foregone entirely if local natural stocks are in jeopardy. The regulatory wording of the plan follows, and is listed in the 1993 Commercial Finfish Regulation Book.

5AAC 18.366. Spiridon Lake Sockeye Salmon Management Plan.

(a) The department shall manage the commercial, sport, and subsistence fisheries in Spiridon Bay to provide for full use of the enhanced stock of sockeye salmon returning to Spiridon Lake.

(b) The purpose of the Spiridon Bay harvest strategy is to allow for the orderly harvest of sockeye salmon returning to Telrod Cove from the Spiridon Lake enhancement project while providing adequate protection for local natural salmon stocks returning to other streams of the bay. The intent of the enhancement project is for the harvest of returning enhanced salmon to occur in traditional commercial fishing areas of the Northwest Kodiak District during openings directed at harvesting Karluk sockeye and westside pink and chum salmon stocks.

(c) The Spiridon Bay Special Harvest Area is that area in Spiridon Bay west of a line from 153°37'21" W. long., 57°38'54" N. lat., to the opposite shore at 153°38'27" W. long., 57°38' N. lat., and east of 153°42'24" W. long.

(d) Only purse seine and beach seines may be operated in the Spiridon Bay Special Harvest Area.

(c) If a harvestable surplus of enhanced sockeye salmon is in the special harvest area, emergency order openings, not to exceed six hours per day and only during daylight hours, will be announced. The openings will be started by an aerial flare launched by an ADF&G representative. When possible, openings will be coordinated to occur at the beginning of openings in the Northwest Kodiak District.

**SOCKEYE SALMON ESCAPEMENTS GOALS FOR AREA K
MAJOR SOCKEYE SALMON SYSTEMS**

For targeted sockeye salmon fisheries on systems having fish weirs the total enumeration of upstream migrants can be used to determine the amount of fishing time required to harvest surplus fish. This commonly occurs for the Karluk, Ayakulik, Upper Station, and Frazer systems (major systems) and for the Akalura, Saltery, Buskin, Litnik, Pauls, and Thorsheim systems (minor systems). For sockeye salmon systems without weirs, fishing time is generally conservative and occurs at the discretion of ADF&G, in proportion to the perceived system specific return strength.

Minimum and desired escapement requirements have been identified for each river's sockeye salmon stocks (Table 9). A basic management function is to achieve minimum escapements for

stocks exploited by targeted fisheries, even if it means that directed fishing time on those stocks does not occur. When the possibility exists that desired escapements may be exceeded, significant deviations from optimum production could occur because of that excess. Maximum directed fishing time on these stocks would be allowed, even if it requires continuous stream terminus fishing to contain the escapement at or near desired levels. These are the extreme scenarios occasionally needed for Kodiak Area sockeye salmon management. More commonly only a moderate amount of directed fishing time is required to harvest sockeye salmon surpluses and to provide escapement which approaches desired levels.

As with the preseason harvest projections, a good tool for illustrating escapements are escapement graphs by stream (Appendix B.1. - B.6.). These are curves drawn based on historical average cumulative escapement by day, scaled to the minimum and desired escapement goal for each particular system. Actual escapements can be plotted on these graphs to compare with the projected cumulative count. Since fishing time is strongly tied to escapement levels, these graphs can be valuable aids in understanding current ADF&G management actions, and in planning for future fisheries. Actual inseason escapement counts can be heard daily at 8:10 A.M. on SSB channel 3230 Khz.

Table 1. Commercial salmon harvest in 1992 and harvest projections for the Kodiak Management Area, 1993.

	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1992 Projected Harvest	10,000	3,247,000	250,000	9,220,000	870,000	13,597,000
1992 Actual Harvest	24,300	4,167,700	280,100	3,310,500	679,500	8,462,100
1993 Projected Harvest	21,000	2,208,000	290,000	21,575,000	1,200,500	25,294,500

FISHERY	1992 HARVEST ^a		1993 HARVEST ^{a,b}
	Projection	Actual ^c	Projection as of 3/30/93
Early Run Sockeye Salmon Fisheries (6/9-7/15)			
Cape Igvak	262,500	161,700	230,000
Karluk	150,000	602,100	350,000
Ayakulik	250,000	957,500	138,000
Frazer	704,000	245,000	232,000
Upper Station	50,000	22,800	35,000
Minor Systems	75,000	16,700	50,000
Other	70,000	470,400	70,000
SubTotal	1,561,500	2,476,200	1,105,000
Late Run Sockeye Salmon Fisheries (7/16-9/15)			
Afognak (Hatchery)	12,000	5,000	18,000
Cape Igvak	97,500	31,300	95,000
Karluk	1,000,000	605,800	325,000
Ayakulik	170,000	141,300	92,000
Frazer	176,000	29,800	58,000
Upper Station	125,000	219,400	410,000
Minor Systems	75,000	15,100	75,000
Other	30,000	643,800	30,000
SubTotal	1,685,500	1,691,500	1,103,000
TOTAL SOCKEYE	3,247,000	4,167,700	2,208,000
Coho Salmon Fisheries (8/1-10/1)			
Afognak (Hatchery)	0	5,000	5,000
Afognak (Natural)	20,000	42,700	35,000
Westside	145,000	100,400	135,000
Alitak	20,000	24,500	25,000
Eastside/Northend Kodiak	25,000	75,600	50,000
Mainland	40,000	31,900	40,000
SubTotal	250,000	280,100	290,000
Pink Salmon Fisheries (7/6-9/5)			
Afognak (Hatchery)	2,320,000	845,400	6,500,000
Afognak (Natural)	700,000	255,700	850,000
Westside Kodiak	4,600,000	1,306,100	4,750,000
Alitak	200,000	59,300	2,870,000
Eastside/Northend Kodiak	600,000	645,400	5,750,000
Mainland	800,000	189,600	855,000
SubTotal	9,220,000	3,310,500	21,575,000

-Continued-

Table 1. (page 2 of 2)

FISHERY	1992 HARVEST ^a		1993 HARVEST ^{a,b}
	Projection	Actual ^c	Projection as of 3/30/93
Chum Salmon Fisheries (6/6-9/5)			
Afognak (Hatchery)	25,000	3,500	500
Afognak (Natural)	30,000	40,200	60,000
Westside Kodiak	300,000	270,700	390,000
Alitak	60,000	34,600	70,000
Eastside/Northend Kodiak	180,000	216,400	275,000
Mainland	275,000	114,100	405,000
SubTotal	870,000	679,500	1,200,500
GRAND TOTAL	13,597,000 ^d	8,462,100 ^e	25,294,500 ^f

^a Numbers of fish.

^b 1993 harvest projections.

^c Actual harvest estimates by fishery as of 11/20/92. Sockeye harvest estimates by fishery has changed as further stock composition work was completed (3/30/93).

^d Includes 10,000 chinook - projected harvest.

^e Includes 24,300 chinook - actual harvest.

^f Includes 21,000 chinook - projected harvest.

Table 2. Expected harvest from supplemental salmon production, by system and species for the Kodiak Management Area, 1993.

System	Sockeye	Pink	Coho	Chum
Kitoi Bay Hatchery Complex ^a	18,000 ^b	6,500,000	5,700	5,000
Spiridon Lake ^c	4,000	0	0	0
Hidden Lake	0	0	2,000	0
Waterfall Lake	0	0	0	0
Malina Lake	0	0	0	0
Crescent Lake ^d	0	0	3,500	0

^a See Eastside Afognak Salmon Management Plan.

^b Harvest is expected to occur during fisheries targeting pink salmon.

^c See Spiridon Lake Sockeye Salmon Management Plan. Based on projected 1993 returns, fishing time is not expected to occur in the Spiridon Bay Special Harvest Area.

^d See Crescent Lake Salmon Management Plan.

Table 3. Commercial salmon season opening times and dates by species for the Kodiak Area, 1993.

FISHERY	EARLIEST OPENING TIME/DATE	
	Firm Time/Date	Approximate Time/Date
Early Run Sockeye Salmon Fisheries		
Cape Igvak Section ^a	-	12:01 A.M. June 5-9
N.W. Kodiak District ^b	12:00 Noon June 9	
Inner Ayakulik and Outer Ayakulik Sections ^c	-	Low tide June 7-9
Alitak District ^b	12:00 Noon June 9	
Minor Systems ^d		
Uganik	-	12:00 Noon June 14
Paramanof	-	12:00 Noon June 14
Pauls/Perenosa	-	12:00 Noon June 14
Litnik	-	12:00 Noon June 9-14
Saltery	-	12:00 Noon June 14
Kafliia/Swikshak	-	12:00 Noon June 14
Pink/Chum Salmon Fisheries ^e		
Mainland District	12:00 Noon July 6	-
Afognak District	12:00 Noon July 6	-
N.W. Kodiak District	12:00 Noon July 6	-
S.W. Kodiak District	12:00 Noon July 6	-
Alitak District	12:00 Noon July 6	-
Eastside Kodiak District	12:00 Noon July 6	-
N.E. Kodiak District	12:00 Noon July 6	-
Late Run Sockeye Salmon Fishery		
Cape Igvak Section ^f	-	12:01 A.M. July (?)
All remaining late run sockeye fisheries ^g	-	12:00 Noon July 15
System Specific Coho Salmon Fisheries ^h		
Mainland District	-	12:00 Noon Sept. 1
Afognak District	-	12:00 Noon Aug. 15
N.W. Kodiak District	-	12:00 Noon Sept. 1
S.W. Kodiak District	-	12:00 Noon Sept. 1
Alitak District	-	12:00 Noon Sept. 1
Eastside Kodiak District	-	12:00 Noon Sept. 5
N.E. Kodiak District	-	12:00 Noon Sept. 5

-Continued-

Table 3. (page 2 of 2)

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- a** Actual opening date will be determined by sockeye escapement levels into the Chignik River system. Fishing time will be in 24 hour increments.
 - b** Actual opening time/date is as shown. This opening is considered a commercial test fishery; fishing time for this initial period will be 33 hours (12:00 noon 6/9 through 9:00 P.M. 6/10).
 - c** Actual opening date will be determined by the sockeye escapement level into Ayakulik River and opening time by low tide timing during daylight hours.
 - d** Actual opening time will be determined by sockeye escapement levels into minor systems. Fishing time for this period will be 33 hours (12:00 noon through 9:00 P.M.)
 - e** Actual opening time/date is as shown. Fishing time for this initial period will be 105 hours (12:00 noon 7/6 through 9:00 P.M. 7/10). See section on Fishing Periods for additional information.
 - f** Actual opening date will be determined by sockeye escapement levels into the Chignik River System. Fishing time will be in 24 hour increments.
 - g** Actual opening date for system specific fishing time will be determined by sockeye escapement levels into major systems. All fishing periods will begin at 12:00 noon and end at 9:00 P.M. prior to 8/16 and end at 6:00 P.M. from 8/16 to season's end.
 - h** Actual opening date for system specific fishing time will be determined by overall coho run strength evaluation and by escapement levels into major systems and minor systems with reliable escapement data.

Table 4. Board of Fisheries approved fishery management plans for the Kodiak Management Area, 1993.

MANAGEMENT PLAN	YEAR INITIATED	MGMT. UNITS AFFECTED	DATES IN EFFECT
Cape Igvak Salmon Management Plan	1978	Cape Igvak Section Wide Bay Section	6/5 - 7/25
Alitak Bay District Salmon Management Plan	1987	Alitak Bay District	6/9 - 10/1
Westside Kodiak Management Plan	1990	N.W. Kodiak District S.W. Kodiak District S.W. Afognak Section	6/9 - 10/1
Crescent Lake Coho Salmon Management Plan	1990	Portion of the Central Section in Vicinity of Port Lions	8/1 - 9/15
North Shelikof Strait Sockeye Salmon Management Plan	1990	S.W. Afognak Section N.W. Afognak Section Shuyak Section Big River Section Hollo Bay Section Inner and Outer Kukak Sect. Dakavak Section	7/6 - 7/25
Eastside Afognak Management Plan	1993	Kitoi Bay Section Izhut Bay Section Duck Bay Section	6/9 - 10/1
Spiridon Bay Sockeye Salmon Management Plan	1993	Special Harvest Area in Spiridon Bay Section	6/9 - 10/1

Table 5. Biological and allocative criteria, and the management chronology, of the Cape Igvak Management Plan for the Kodiak Management Area, 1993.

BIOLOGICAL AND ALLOCATIVE CRITERIA FOR MANAGING THE CAPE IGVAK FISHERY ON CHIGNIK BOUND SOCKEYE

BIOLOGICAL REQUIREMENTS			ALLOCATIVE REQUIREMENTS		
REGULATION 5AAC 18.360	ESCAPEMENT NEEDS		REGULATION 5AAC 18.360	CHIGNIK MINIMUM HARVEST	IGVAK %
	CHIGNIK (EARLY RUN)	CHIGNIK (LATE RUN)			
(a) (b) (c)	THROUGH 6/30 350,000-400,000	-	(a)	EXPECTATIONS OF LESS THAN 600,000	CLOSED
-	-	-	(b)	EXPECTATIONS OF 600,000 ARE IN DOUBT	CLOSED
(a) (b) (c)	-	THROUGH 7/30 195,000-200,000	(c)	EXPECTATIONS OF 600,000 OCCUR	OPEN TO ACHIEVE 15%
-	-	-	(d)	CHIGNIK SALMON % INTERCEPTION CALCULATIONS	80% OF CATCH AT IGVAK ARE CHIGNIK SOCKEYE
-	-	-	(e)	ALLOCATION PERIOD 600,000	6/5 - 7/25 % NOT APPLICABLE
(f)	FROM JUNE 26 - JULY 9 CAPE IGVAK SECTION CLOSED OR SEVERLY LIMITED UNTIL CHIGNIK LAKE RUN EVALUATED		-	-	-
-	-	-	(g)	-	ONE DAY ADVANCE NOTICE
	400,000	250,000		600,000 MINIMUM	15 %

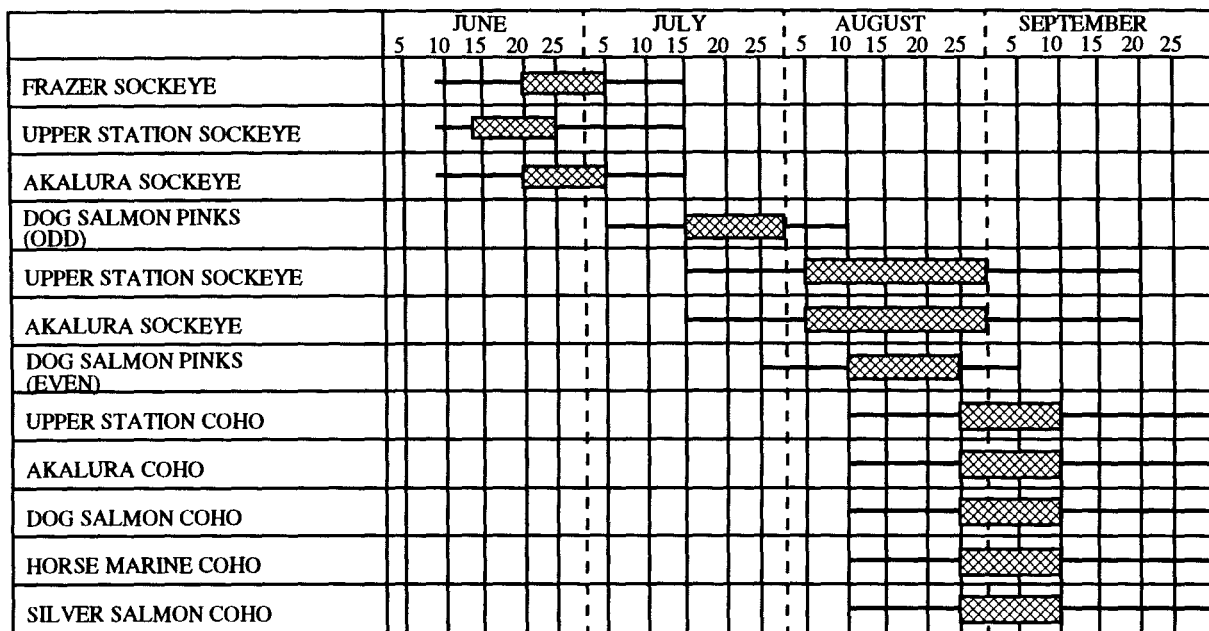
MANAGEMENT CHRONOLOGY FOR CHIGNIK BOUND SOCKEYE AND KODIAK SALMON

CLOSED 6/1	CHIGNIK SOCKEYE STOCKS (EARLY RUN) 6/5	CLOSED OR SEVERLY LIMITED 6/26	CHIGNIK SOCKEYE STOCKS (LATE RUN) 7/9	KODIAK BOUND STOCKS AND/OR CHIGNIK LATE RUN STOCKS 7/25	9/5
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Table 6. Primary management species and fishery chronology of the Alitak Bay District Salmon Management Plan for the Kodiak Management Area, 1993

ALITAK BAY DISTRICT MANAGEMENT PLAN									
CAPE ALITAK SECTION (SEINE)	CLOSED	XXXXXX	FRAZER SOCKEYE (AGGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ODD YEAR CYCLE FRAZER PINK SALMON	ODD YEAR CYCLE UP.STATION SOCKEYE	ALL ALITAK DISTRICT COHO SYSTEMS		
					EVEN YEAR CYCLE UP.STATION SOCKEYE (LATE RUN)	EVEN YEAR CYCLE UP.STATION SOCKEYE & FRAZER PINK SALMON			
MOSER/OLGA BAY SECTION (GILLNET) (TRADITIONAL)	CLOSED	XXXXXX	FRAZER SOCKEYE (AGGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ODD YEAR CYCLE FRAZER PINK SALMON	ODD YEAR CYCLE UP.STATION SOCKEYE	ALL OLGA BAY COHO SYSTEMS		
					EVEN YEAR CYCLE UP.STATION SOCKEYE (LATE RUN)	EVEN YEAR CYCLE UP.STATION SOCKEYE & FRAZER PINK SALMON			
OUTER UPPER & INNER UPPER STATION (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	UPPER STATION SOCKEYE (EARLY RUN)		UPPER STATION SOCKEYE (LATE RUN)		UP. STATION SOCK & COHO	UPPER STATION COHO	
OUTER AKALURA & IN. AKALURA SECTIONS (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	AKALURA SOCKEYE (EARLY RUN)		AKALURA SOCKEYE (LATE RUN)		AKALURA SOCK & COHO	AKALURA COHO	
DOG SALMON FLATS SECTION (GILLNET) (NON-TRADITIONAL)	CLOSED	CLOSED	FRAZER SOCKEYE (MOP UP FISHERY)		FRAZER PINK SALMON		FRAZER AND HORSE MARINE COHO		
HUMPY/DEADMAN SECTION (SEINE)	CLOSED	XXXXXX	FRAZER SOCKEYE (AGRESSIVE MANAGEMENT STRATEGY)	FRAZER SOCKEYE (CONSERVATIVE MANAGEMENT STRATEGY)	ALITAK BAY PINK, CHUM, AND COHO				
6/1		6/9-10		6/24 7/9 7/15		8/9		8/20 8/26 9/25	

ALITAK BAY DISTRICT - PRIMARY MANAGEMENT SPECIES BY STREAM BY TIME



AVAILABLE TO FISHERY

CRITICAL MGMT. PERIOD

Table 7. Primary management species and fishery chronology of the Westside Kodiak Management Plan for the Kodiak Management Area, 1993.

		6/1	6/9	6/16	6/23	7/6	7/16	8/1	8/16	8/25	9/6	10/31
AFOG. DIST.	S.W.AFOGNAK		CLOSED		E.R.KARLUK SOCKEYE		LOCAL AND MIXED PINK		L.R.KARLUK SOCKEYE/LOCAL & MIXED PINK	L.R.KARLUK SOCKEYE		LOCAL COHO
	NORTH CAPE: CENTRAL		CLOSED		E.R.KARLUK SOCKEYE		LOCAL AND MIXED PINK		L.R.KARLUK SOCKEYE/LOCAL & MIXED PINK	L.R.KARLUK SOCKEYE		LOCAL COHO
	ANTON LARSEN											
	SHERATIN											
	KIZHUYAK											
	TERROR											
	IN. UGANIK											
	SPIRIDON											
	ZACHAR											
	UYAK											
SOUTHWEST KODIAK DISTRICT	OUT.KARLUK		CLOSED		E.R. KARLUK SOCKEYE		ODD-YEAR CYCLE: L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE			KARLUK COHO
	IN.KARLUK		CLOSED		E.R. KARLUK SOCKEYE		EVEN-YEAR CYCLE: L.R. KARLUK SOCKEYE/PINK		L.R. KARLUK SOCKEYE			KARLUK COHO
	STURGEON		CLOSED		E.R.KARLUK & AYAKULIK SOCKEYE & STURGEON CHUM		ODD-YEAR CYCLE: L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE			LOCAL COHO
	HALIBUT		CLOSED		E.R.KARLUK AND AYAKULIK SOCKEYE		ODD-YEAR CYCLE: L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE			LOCAL COHO
	OUT.AYAKULIK		CLOSED		E.R. AYAKULIK SOCKEYE		ODD-YEAR CYCLE: L.R. AYAKULIK SOCKEYE					AYAKULIK COHO
	IN.AYAKULIK		CLOSED		E.R. AYAKULIK SOCKEYE		EVEN-YEAR CYCLE: L.R. AYAKULIK SOCKEYE/PINK					AYAKULIK COHO
							ODD-YEAR CYCLE: L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE			
							EVEN-YEAR CYCLE: L.R. L.R. KARLUK SOCKEYE		L.R. KARLUK SOCKEYE			
							AYAKULIK RED & PINK		& AYAKULIK PINK			
		6/1	6/9	6/16	6/23	7/6	7/16	8/1	8/16	8/25	9/6	10/31



COMMERCIAL TEST FISHERIES

E.R. = EARLY RUN STOCKS

L.R. = LATE RUN STOCKS

Table 8. Primary management species and fishery chronology of the Eastside Afognak Management Plan for the Kodiak Management Area, 1993.

TARGETED SPECIES BY SYSTEM AND TIME FOR SPECIFIC MANAGEMENT UNITS ^{1/}																
S.E. AFOGNAK SECTION (Seine)	LITNIK SOCKEYE	LITNIK SOCKEYE	LITNIK SOCKEYE	LITNIK SOCKEYE	LOCAL PINK								LOCAL COHO			
DUCK BAY SECTION (Seine)	EARLY HATCHERY CHUM AND/OR SOCKEYE				HATCHERY & LOCAL PINK								LOCAL COHO			
IZHUT BAY SECTION (Seine)	EARLY HATCHERY CHUMS AND/OR SOCKEYE				CLOSED UNTIL COST RECOVERY ASSURED				HATCHERY & LOCAL PINK				LOCAL COHO & HATCHERY SOCKEYE			
KITOI BAY SECTION ^{2/} (Seine) Broodstock									a							
PINK: Cost Recovery					b											
Common Property							c									
CHUM &/OR Broodstock EARLY SOCKEYE				d												
Common Property	e															
COHO & Broodstock SOCKEYE:											f					
Common Property											g					
6/9 6/14 6/20 7/1 7/3 7/6 7/18 7/20 7/25 8/1 8/8 8/15 8/20 8/24 9/1																

☒ - fishing time dependant upon sockeye escapement into Litnik system.

- Included in this management plan are the harvest strategies for current natural and hatchery production as well as future hatchery production.
- The management plan required for the Kitoi Bay Section is rather complicated in order to achieve broodstock, cost recovery, and common harvest requirements. This is further complicated by the multispecies production currently occurring at Kitoi Bay hatchery. The diagram shown attempts to approximate dates for when specific management strategies should be implemented to insure achievement of hatchery goals and an orderly harvest of quality common property fish.
 - Hatchery pink salmon broodstock captured.
 - Hatchery pink salmon cost recovery fishery when necessary.
 - Hatchery pink salmon common property fishery.
 - Hatchery chum and/or early sockeye salmon broodstock captured.
 - Hatchery chum and/or early sockeye salmon common property fishery.
 - Hatchery coho and late sockeye salmon broodstock captured.
 - Hatchery coho and late sockeye salmon common property fishery.

Table 9. Sockeye salmon escapement goals for major and minor systems in millions of fish, for the Kodiak Management Area, 1993.

	<u>Early Run (Before 7/15)</u>		<u>Late Run (After 7/15)</u>		<u>Total</u>	
	Minimum	Desired	Minimum	Desired	Min.	Des.
Major Systems						
Karluk ^b	.150	.250	.400	.550	.550	.800
Ayakulik	.160	.220	.040	.080	.200	.300
Upper Station ^b	.050	.075	.150	.200	.200	.275
Frazer ^c	.140	.200	-	-	.140	.200
Subtotal	.500	.745	.590	.830	1.090	1.575
Minor Systems						
Akalura ^b	.010	.015	.030	.045	.040	.060
Saltery ^c	.020	.040	-	-	.020	.030
Buskin ^c	.010	.015	-	-	.010	.015
Litnik ^c	.040	.060	-	-	.040	.060
Pauls ^c	.020	.040	-	-	.020	.040
Thorsheim ^c	.005	.010	-	-	.005	.010
Subtotal	.015	.180	.030	.045	.120	.205
GRAND TOTAL	.605	.925	.620	.875	1.225	1.790

^a This listing of systems identifies only those systems whose escapement is monitored by fish weir total escapement counts. The escapement into these systems represents approximately 85% of the Kodiak Area's total sockeye escapement.

^b Sockeye escapement into these systems characterized by two (2) more or less distinct stocks as identified by bimodal escapement pattern, i.e. an early stock where the cumulative escapement occurs through July 15 and a late stock where the cumulative escapement occurs primarily from July 16 through season's end.

^c Sockeye escapement into these systems characterized by one (1) distinct escapement pattern and where escapement is essentially completed by approximately July 25. Escapement goals for Pauls Bay are currently being reevaluated.

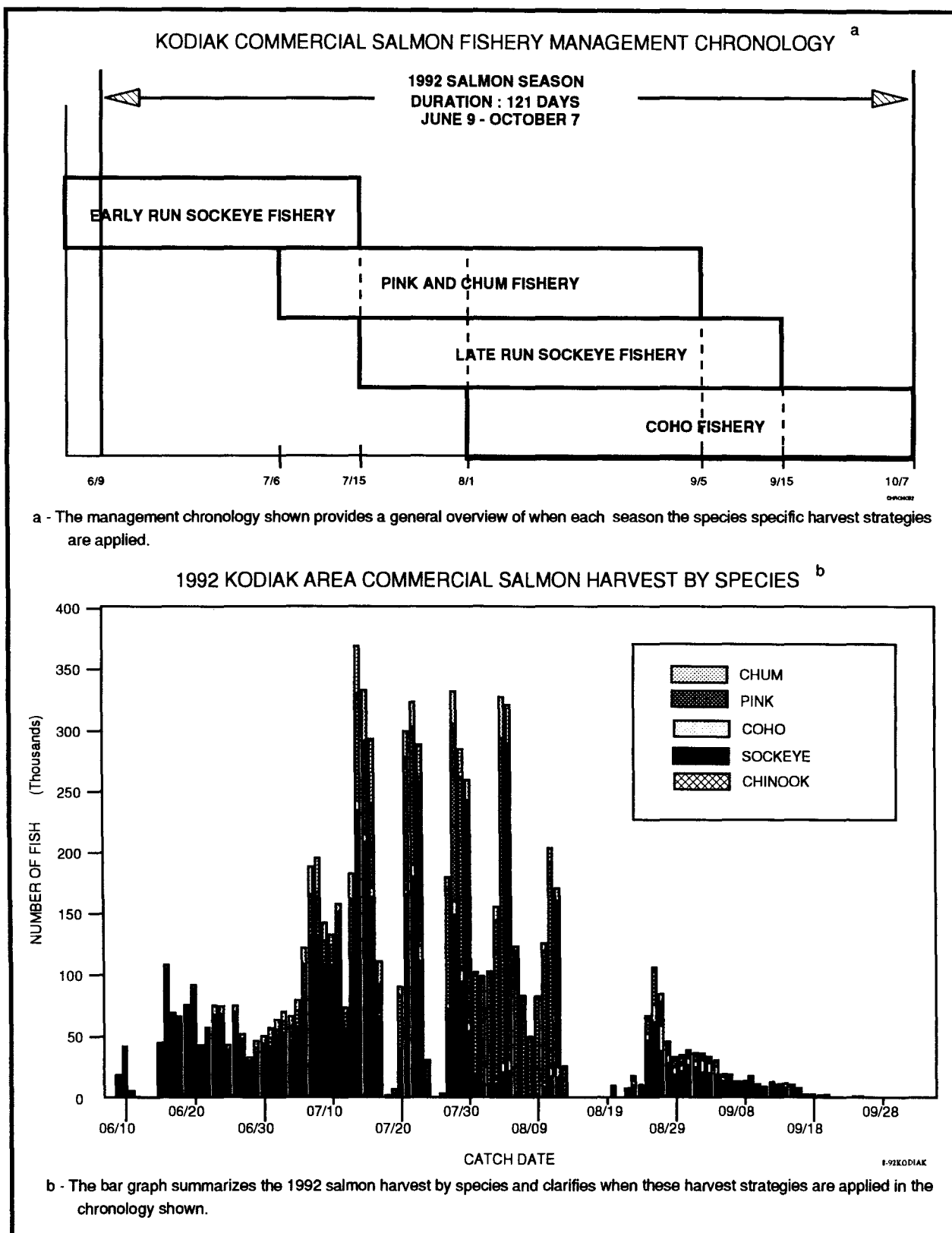


Figure 1. Salmon management chronology and commercial harvest by species in the Kodiak Management Area, 1992.

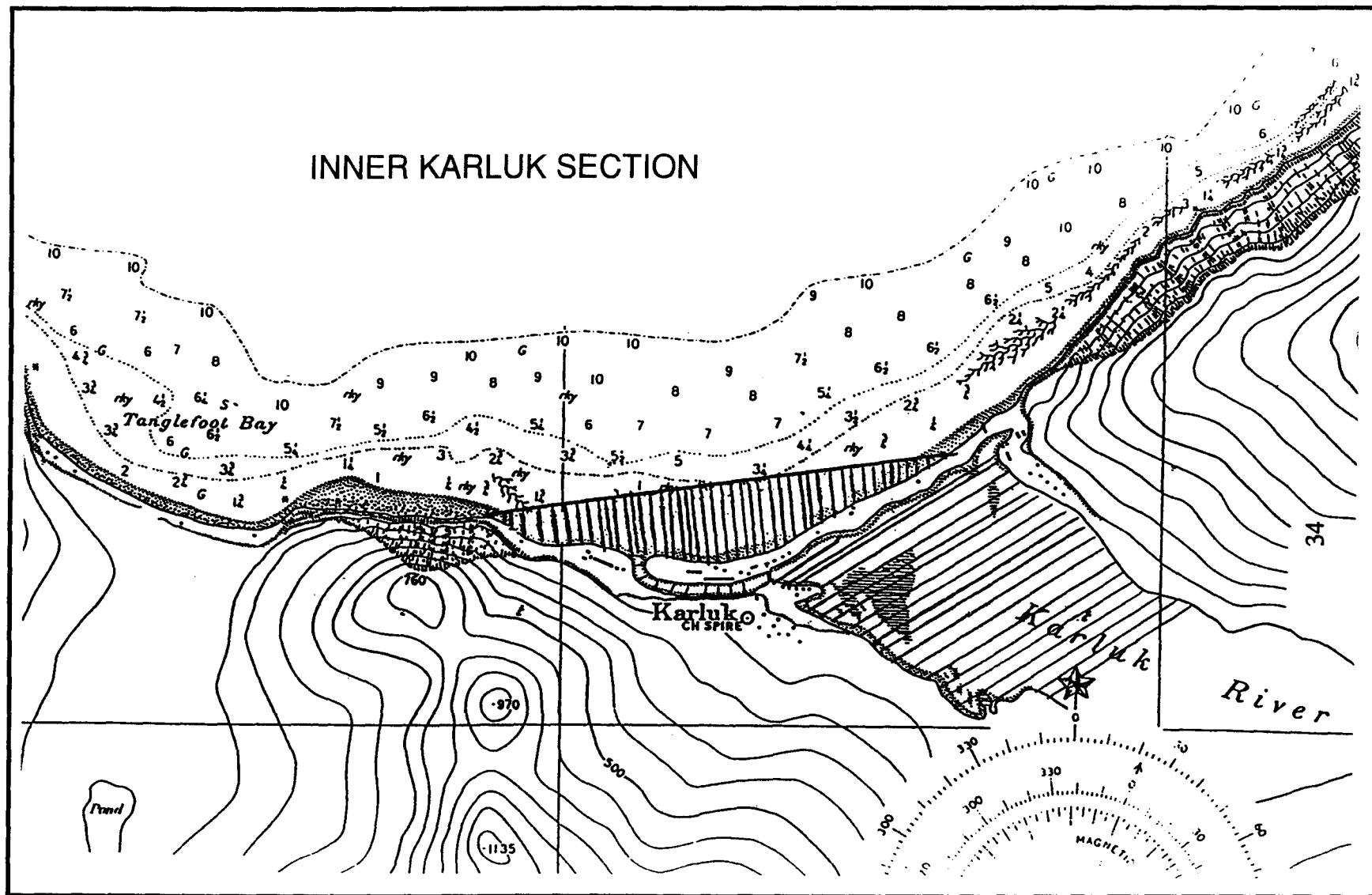


Figure 2. Karluk River closed water sanctuary in the Kodiak Management Area, 1993.

ALASKA DEPARTMENT OF FISH AND GAME
BUSKIN RIVER CLOSED WATER SANCTUARY
FOR THE COMMERCIAL AND SUBSISTENCE
SALMON FISHERY

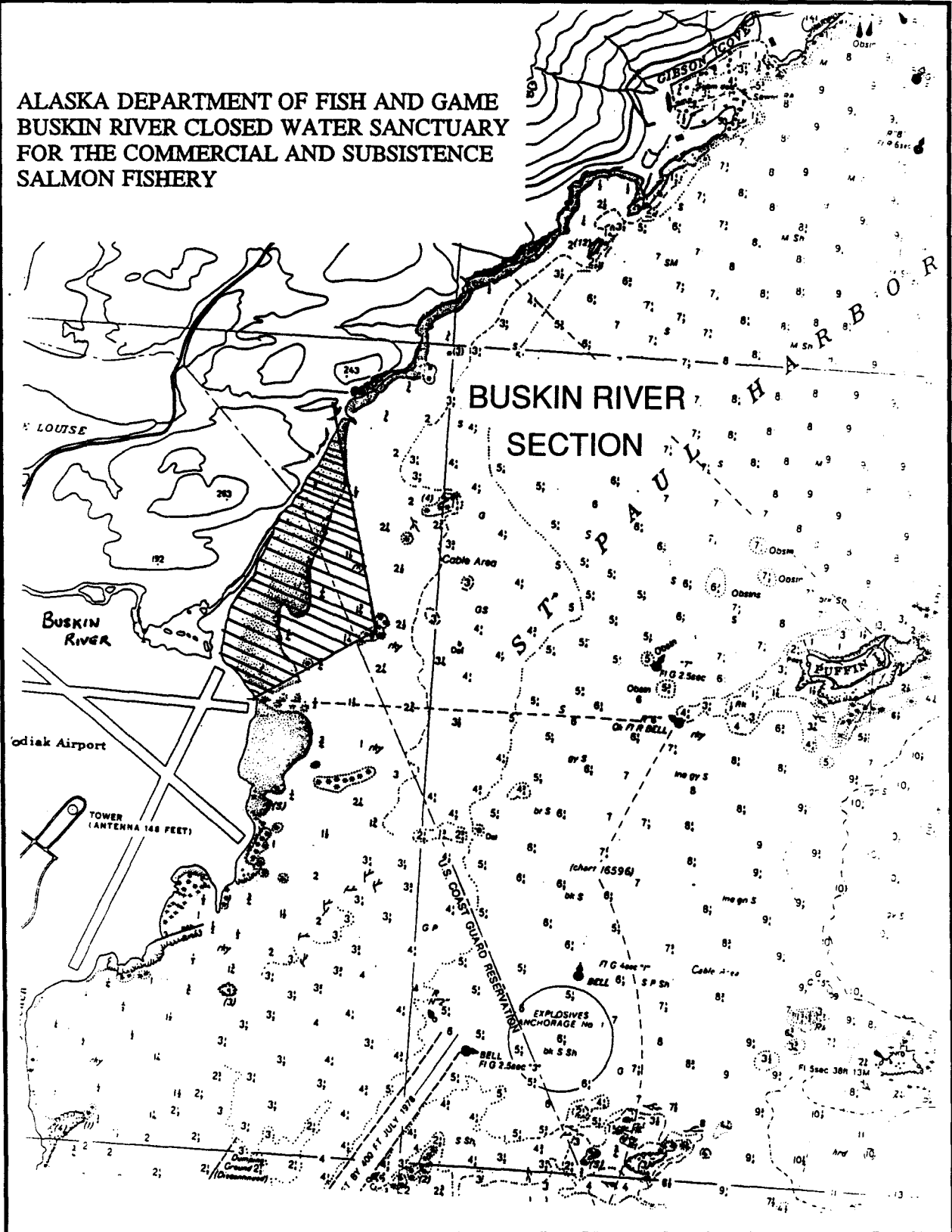


Figure 3. Buskin River closed water sanctuary in the Kodiak Management Area, 1993.

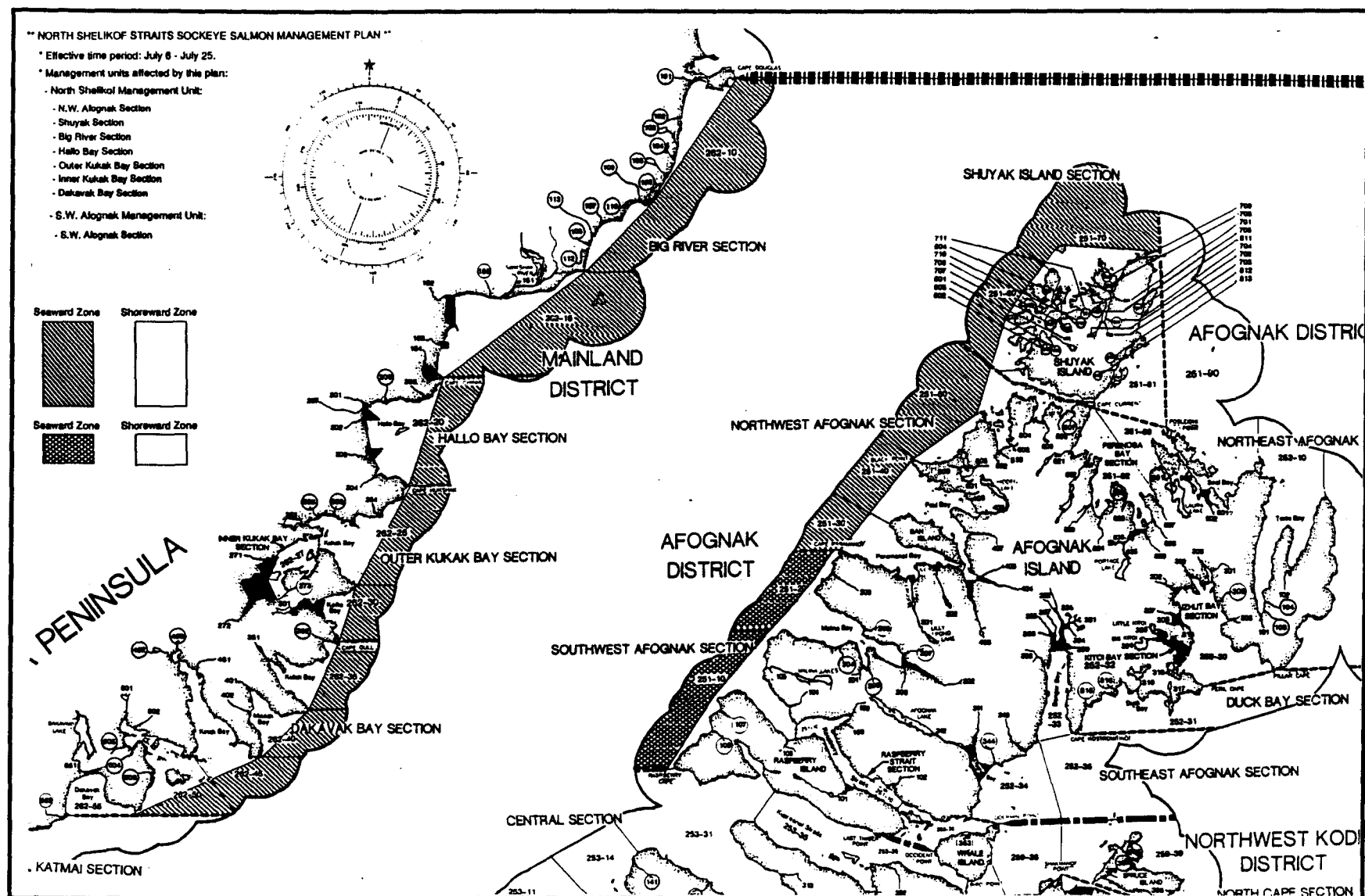


Figure 4. Approximate boundaries of the "North Shelikof Seaward Zone" and the "Southwest Afognak Seaward Zone" of the North Shelikof Strait Sockeye Salmon Management Plan for the Kodiak Management Area, 1993.

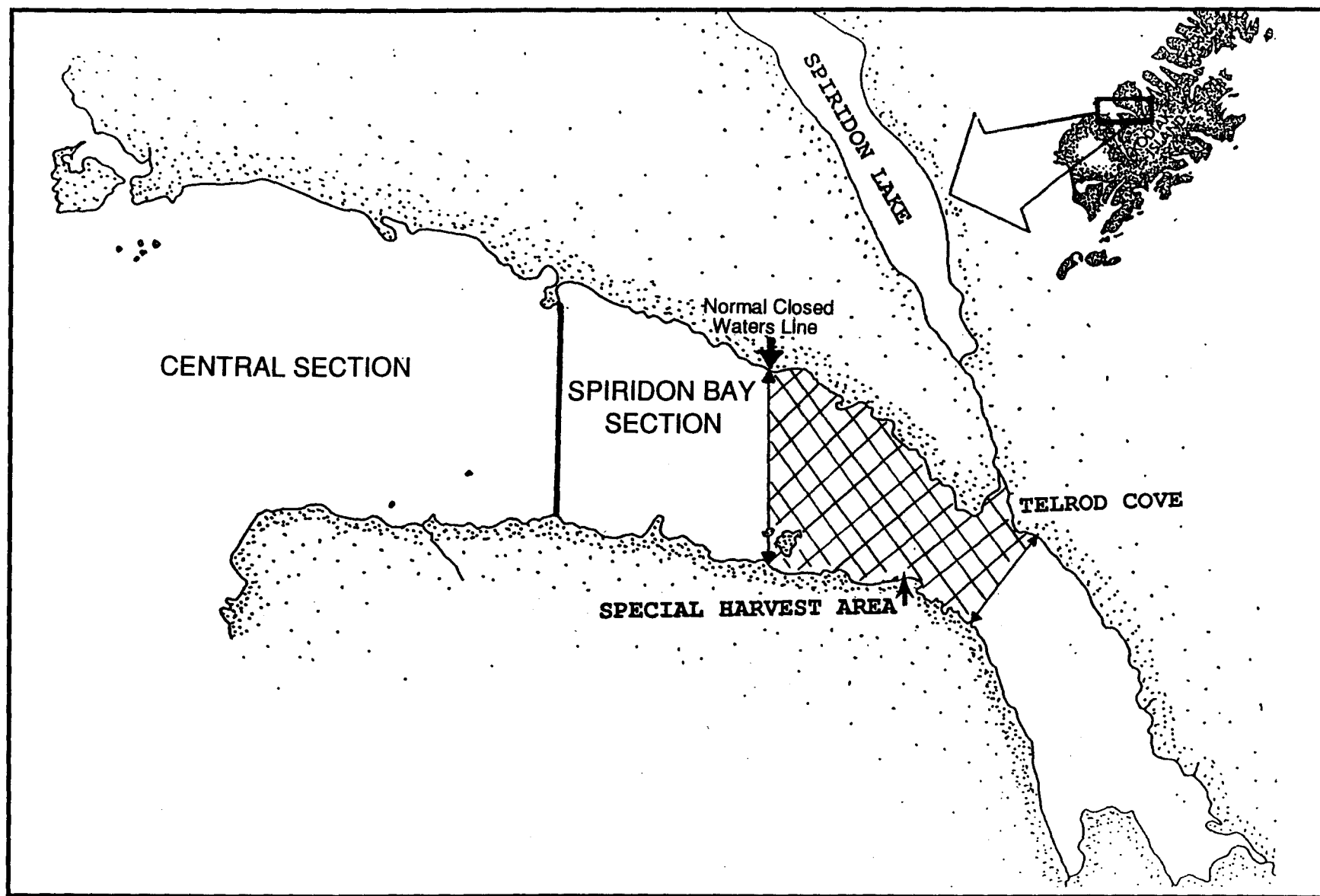
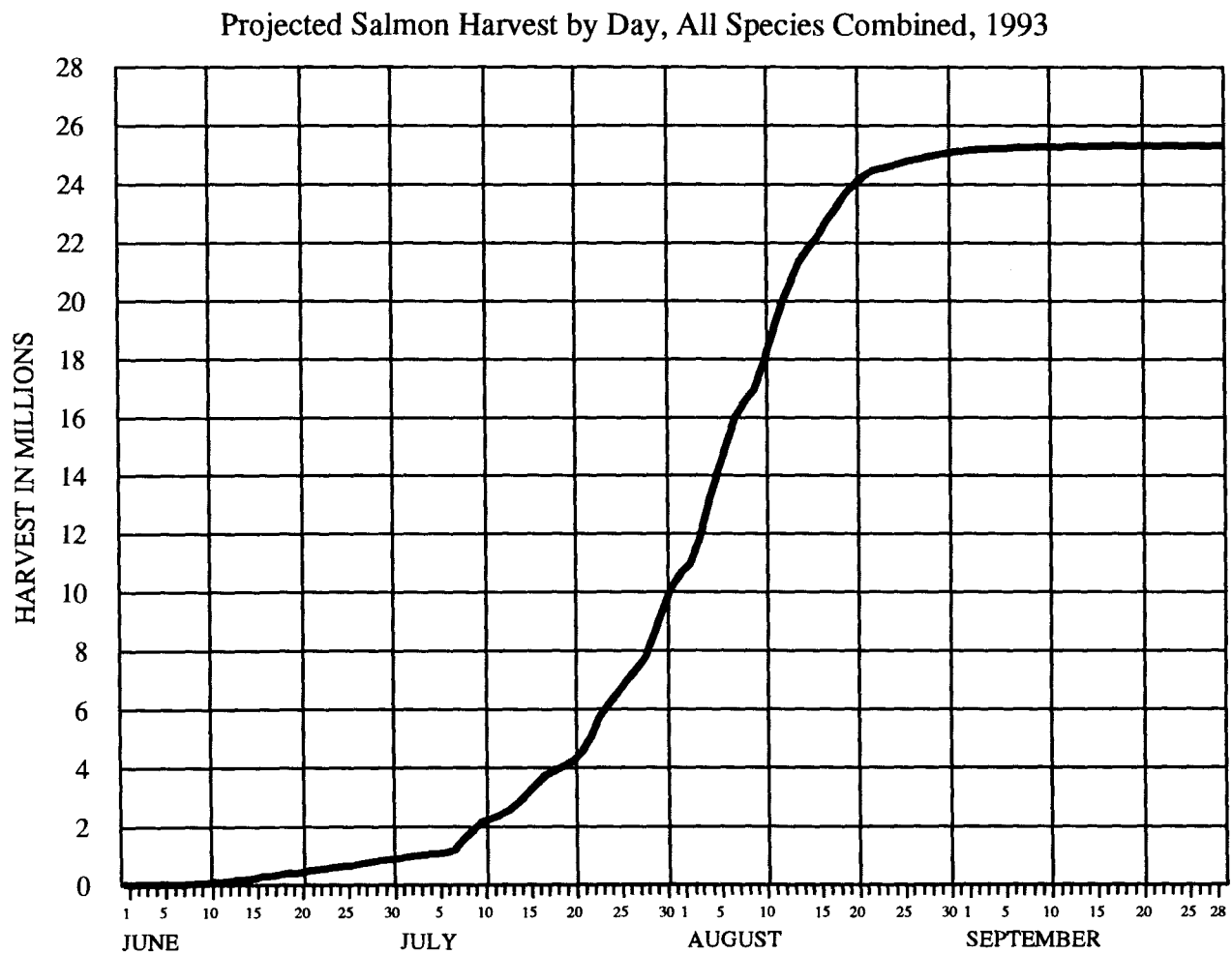


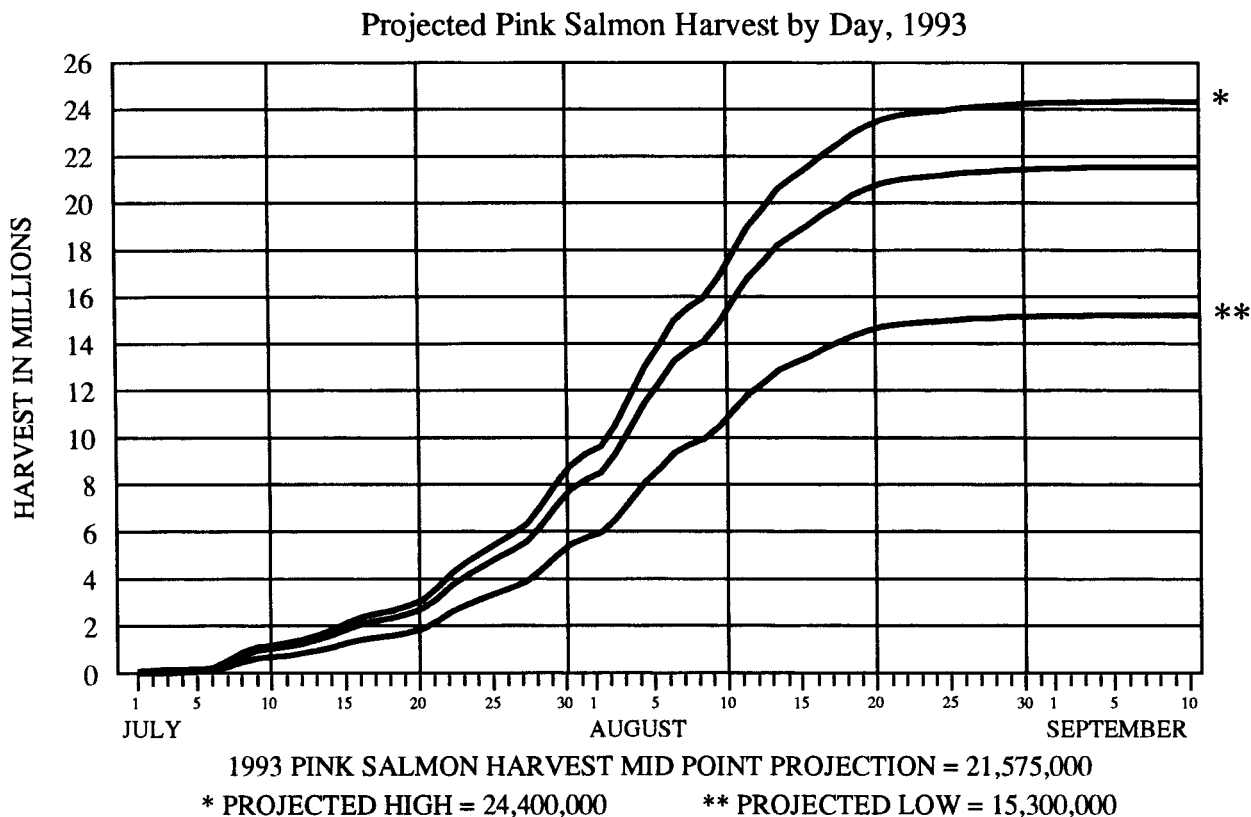
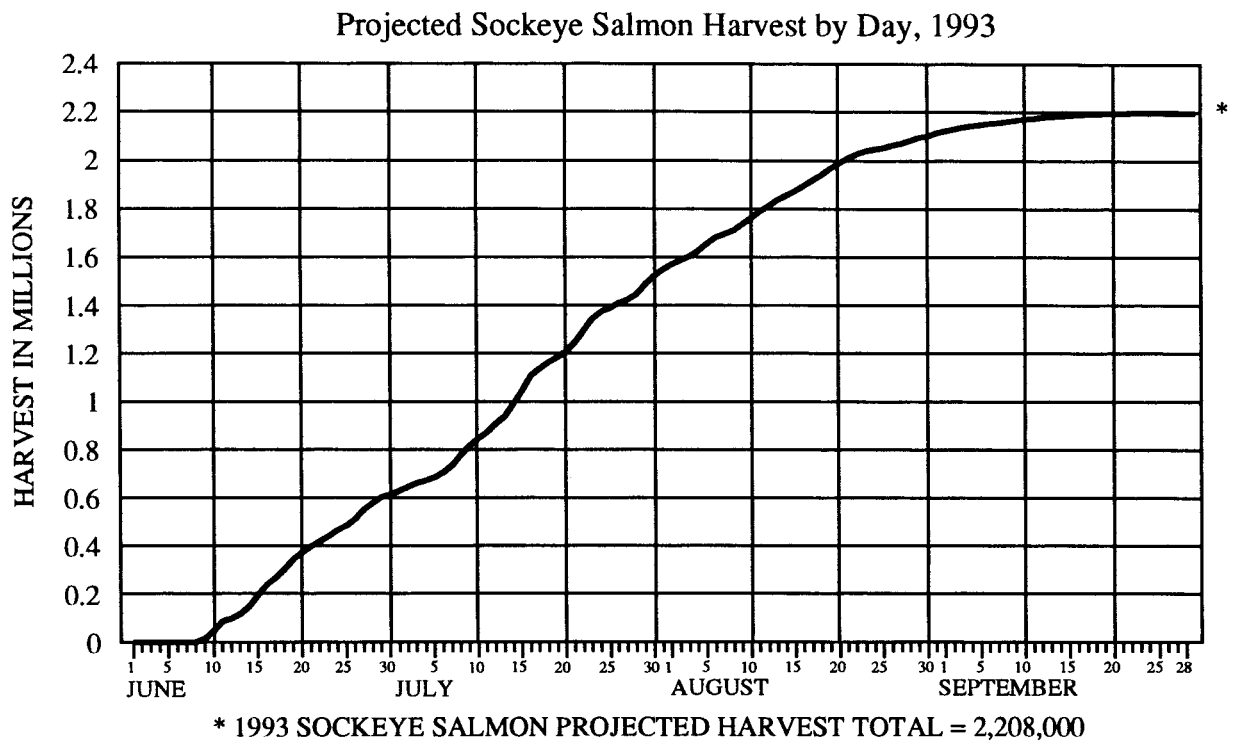
Figure 5. Approximate boundaries of the Special Harvest Area of the Spiridon Bay Sockeye Salmon Management Plan for the Kodiak Management Area, 1993.

APPENDIX

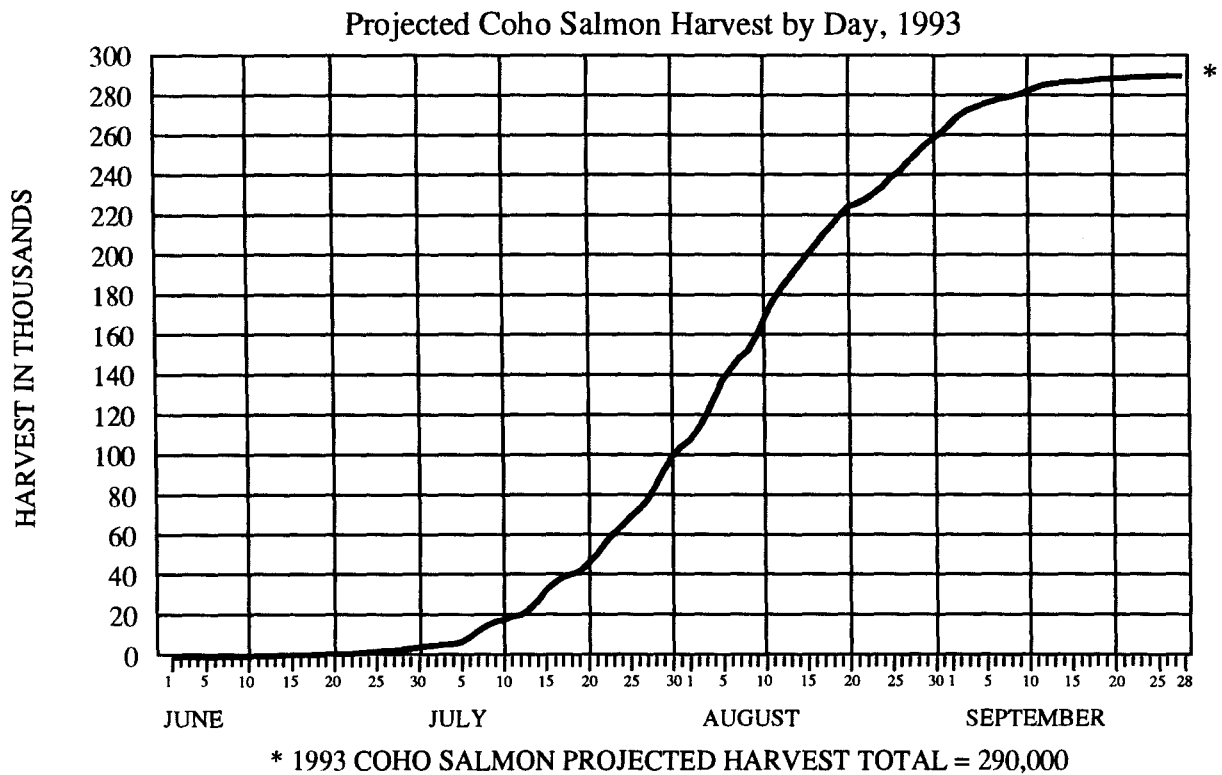
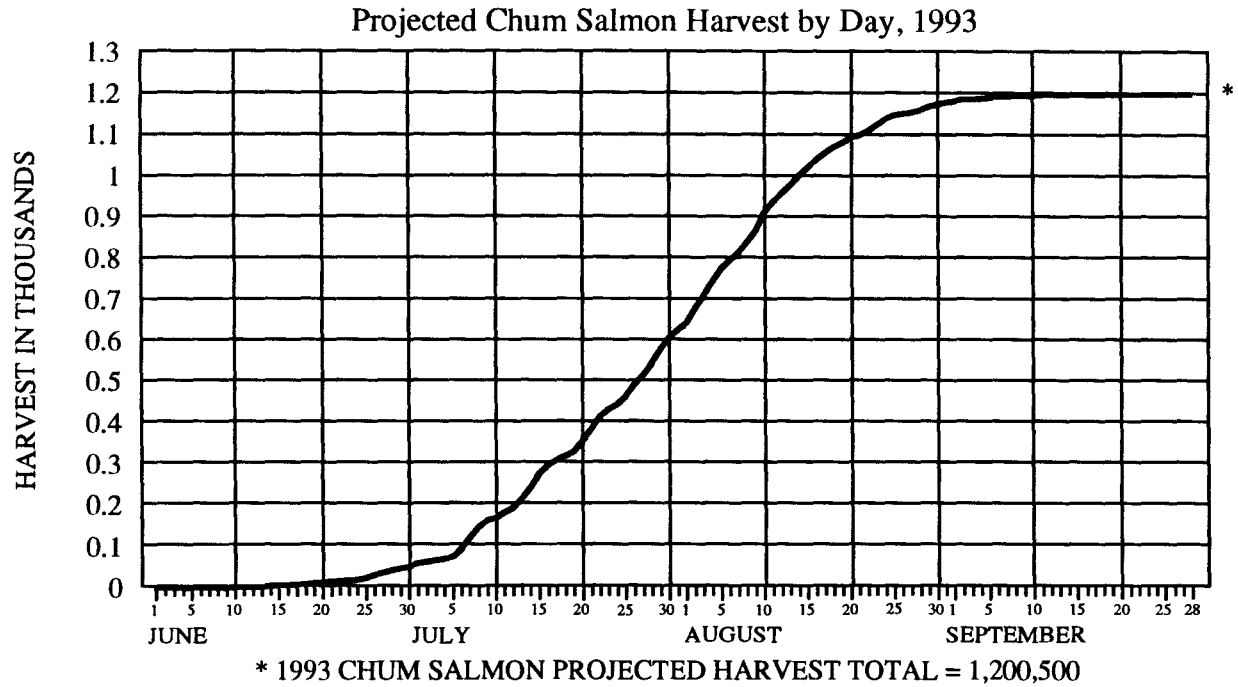


* 1993 ALL SALMON SPECIES PROJECTED HARVEST TOTAL = 25,294,500

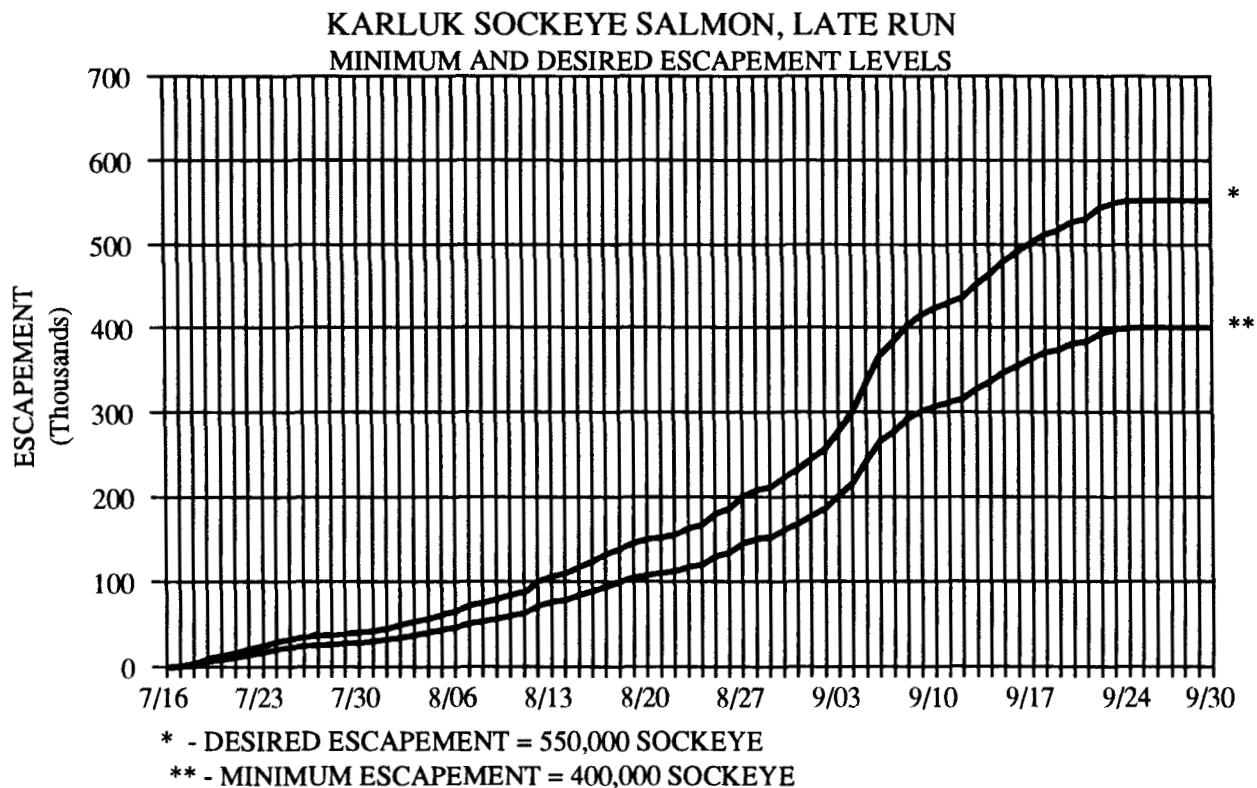
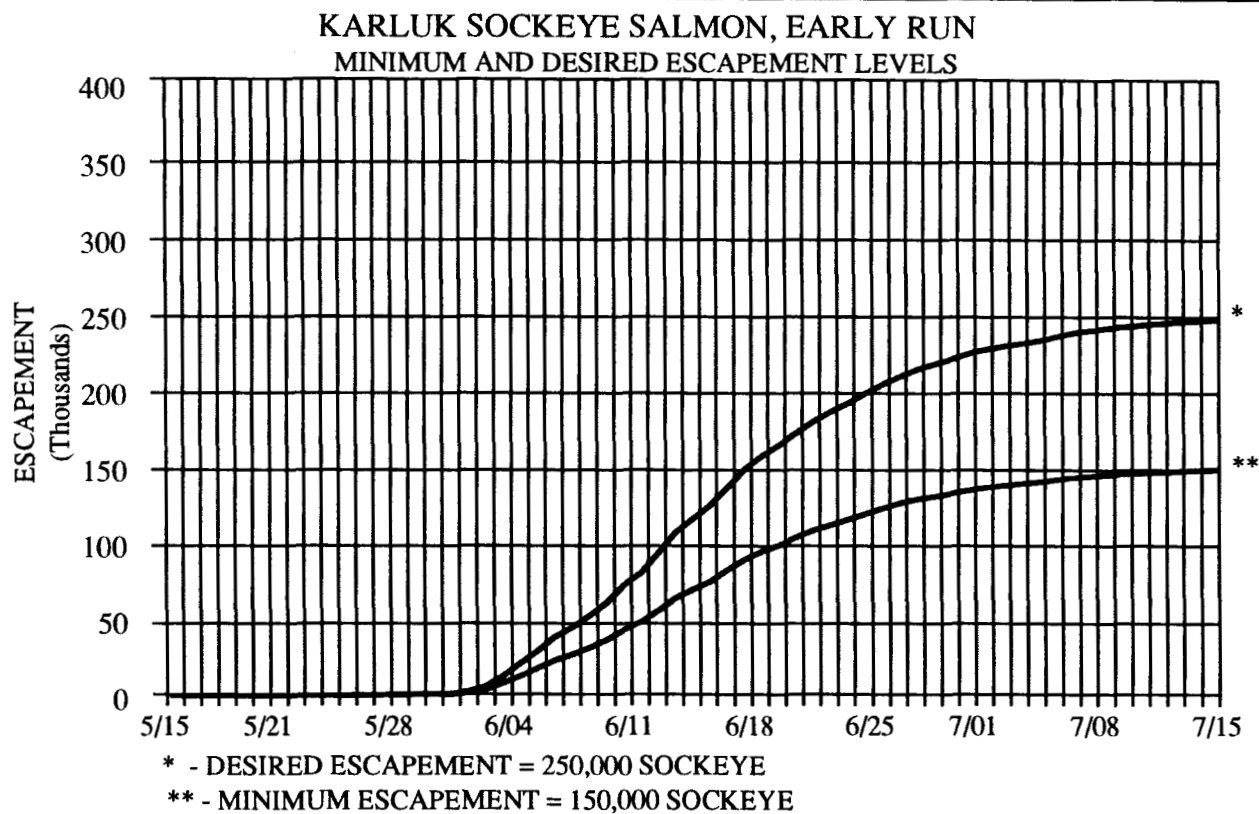
Appendix A.1. Projected salmon harvest graph, all species combined, for the Kodiak Management Area, 1993



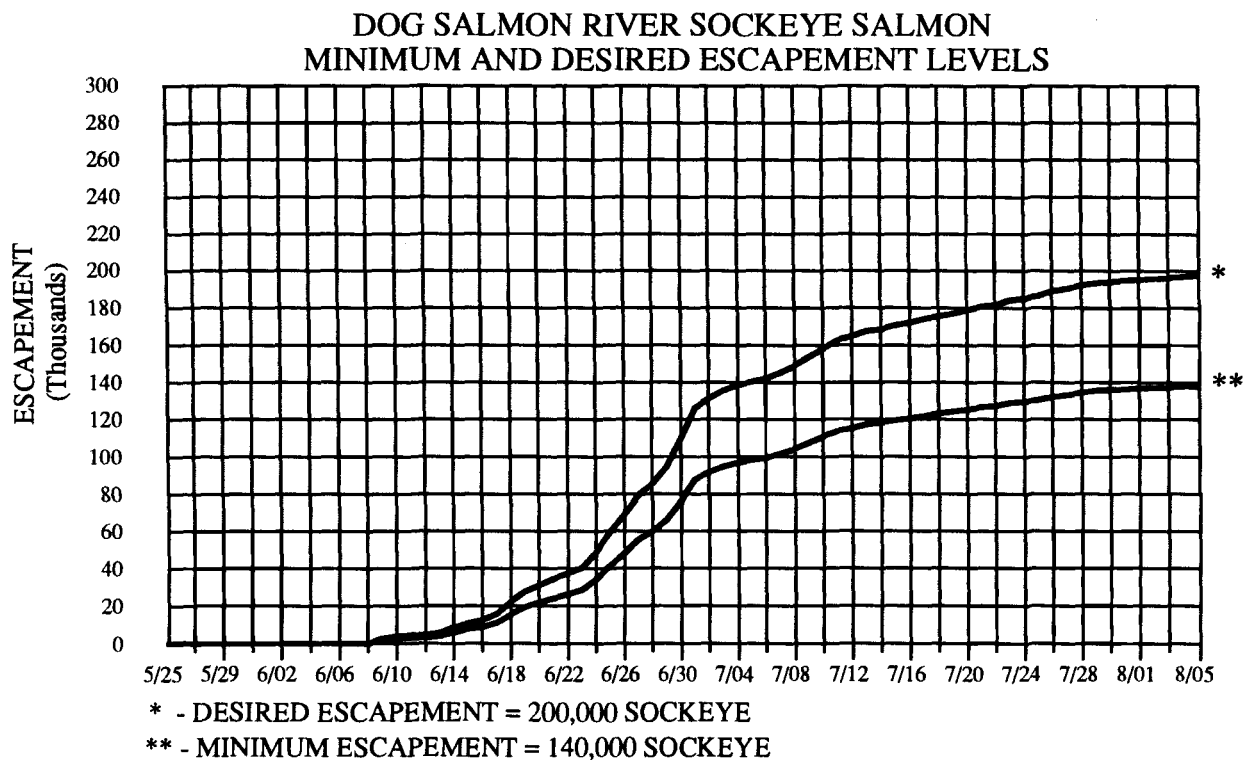
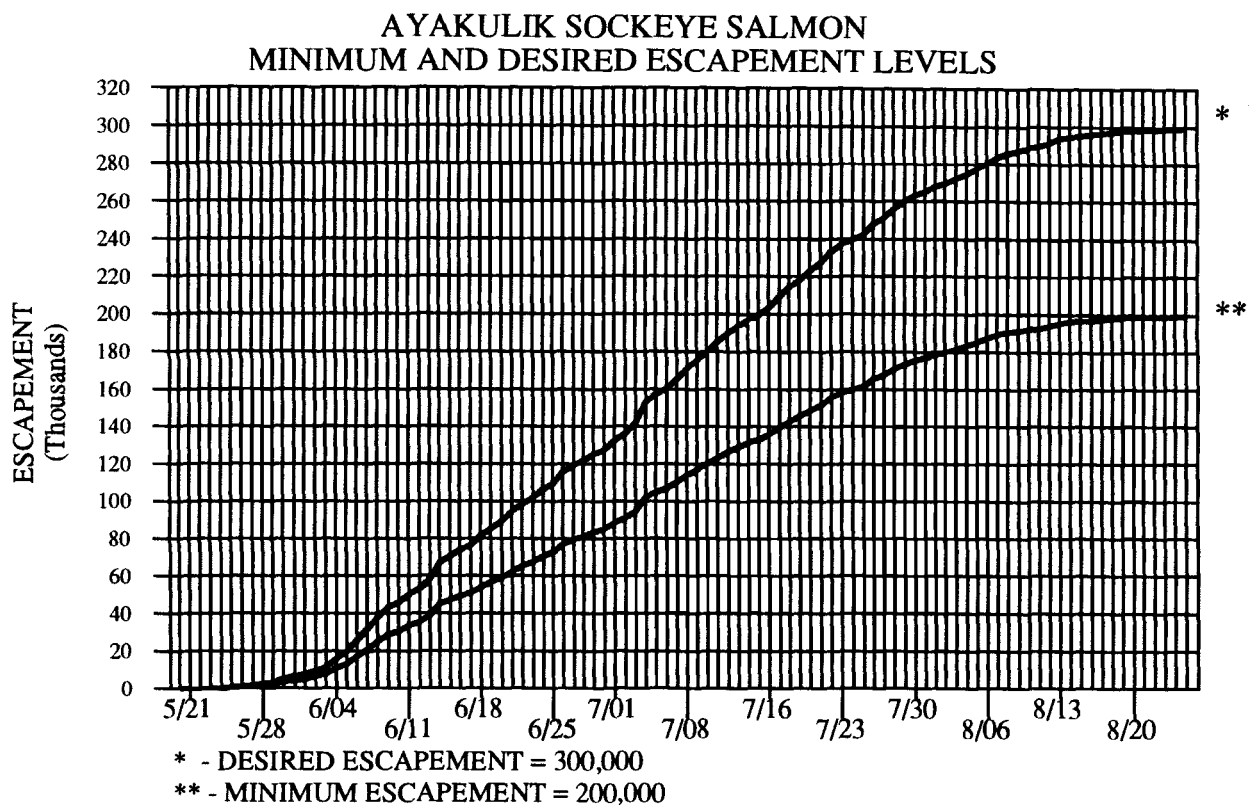
Appendix A.2. Projected sockeye and pink salmon harvest graphs for the Kodiak Management Area, 1993



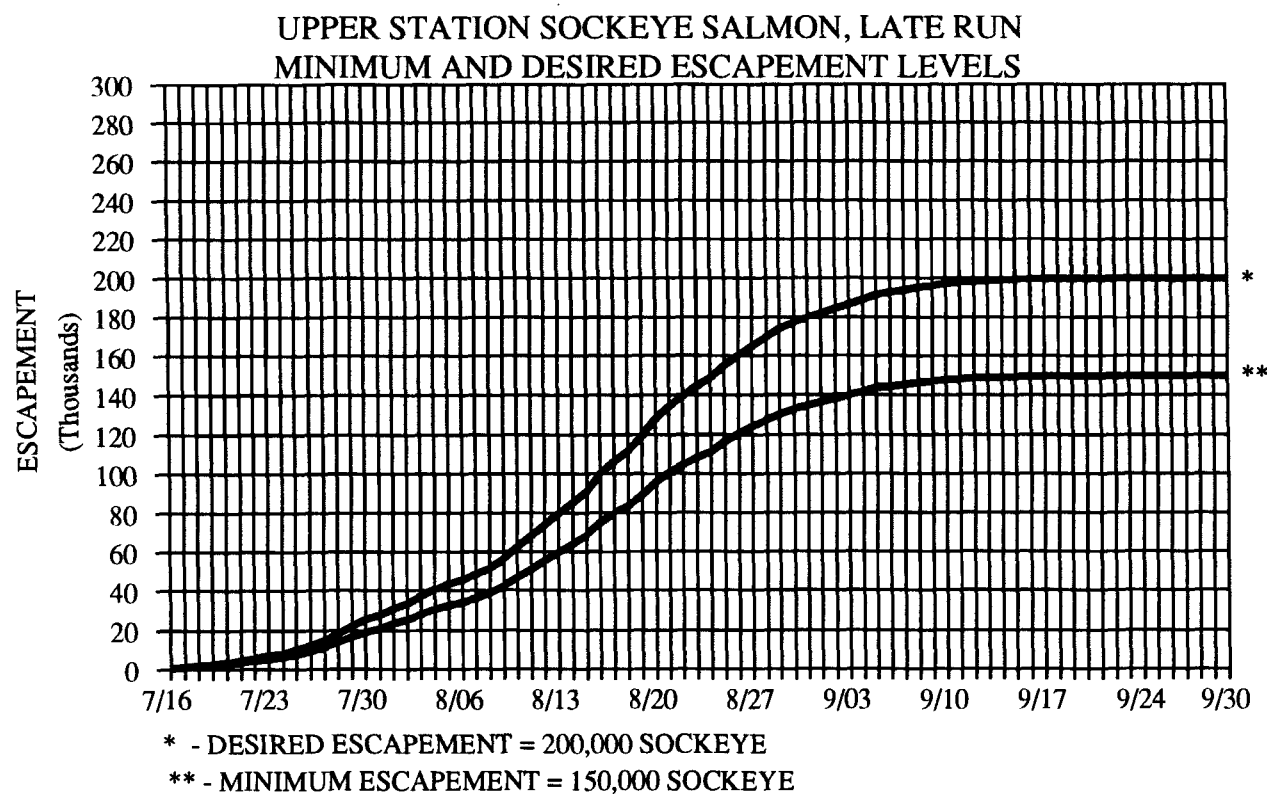
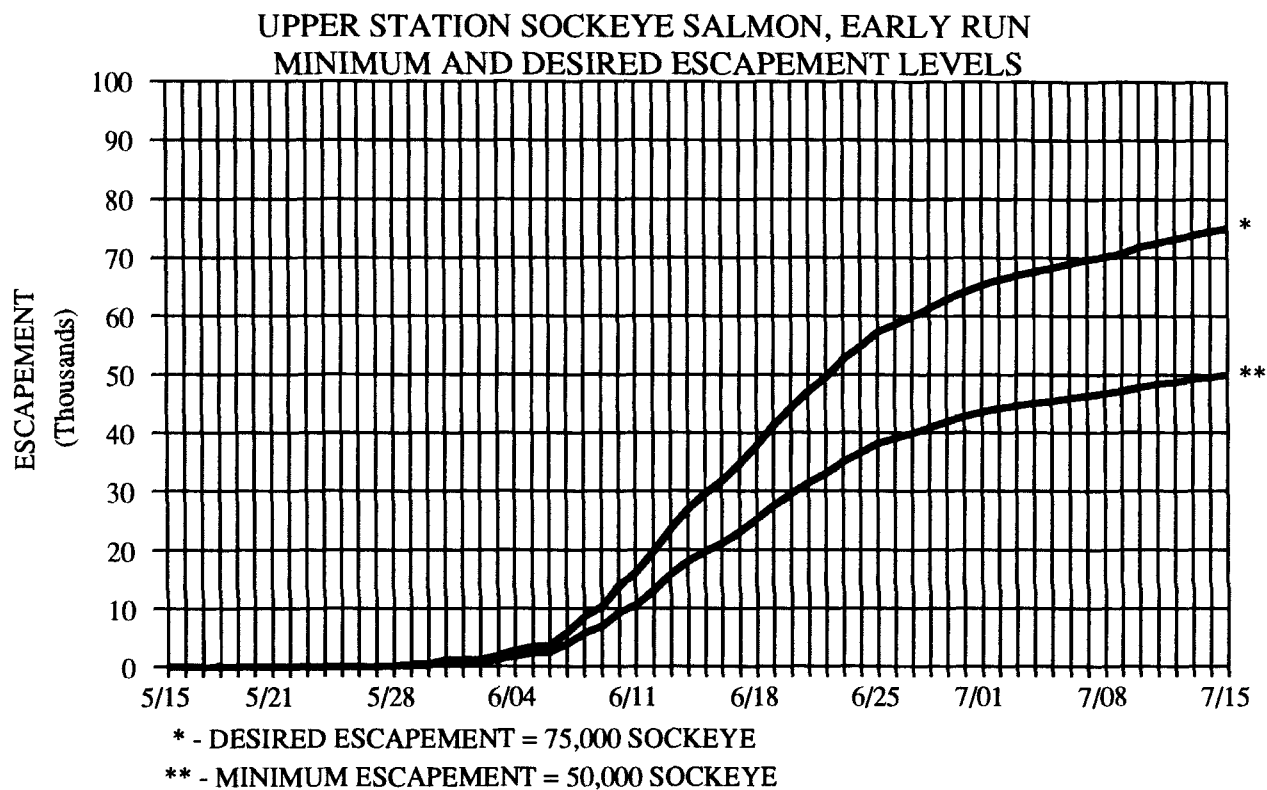
Appendix A.3. Projected chum and coho salmon harvest graphs for the Kodiak Management Area, 1993



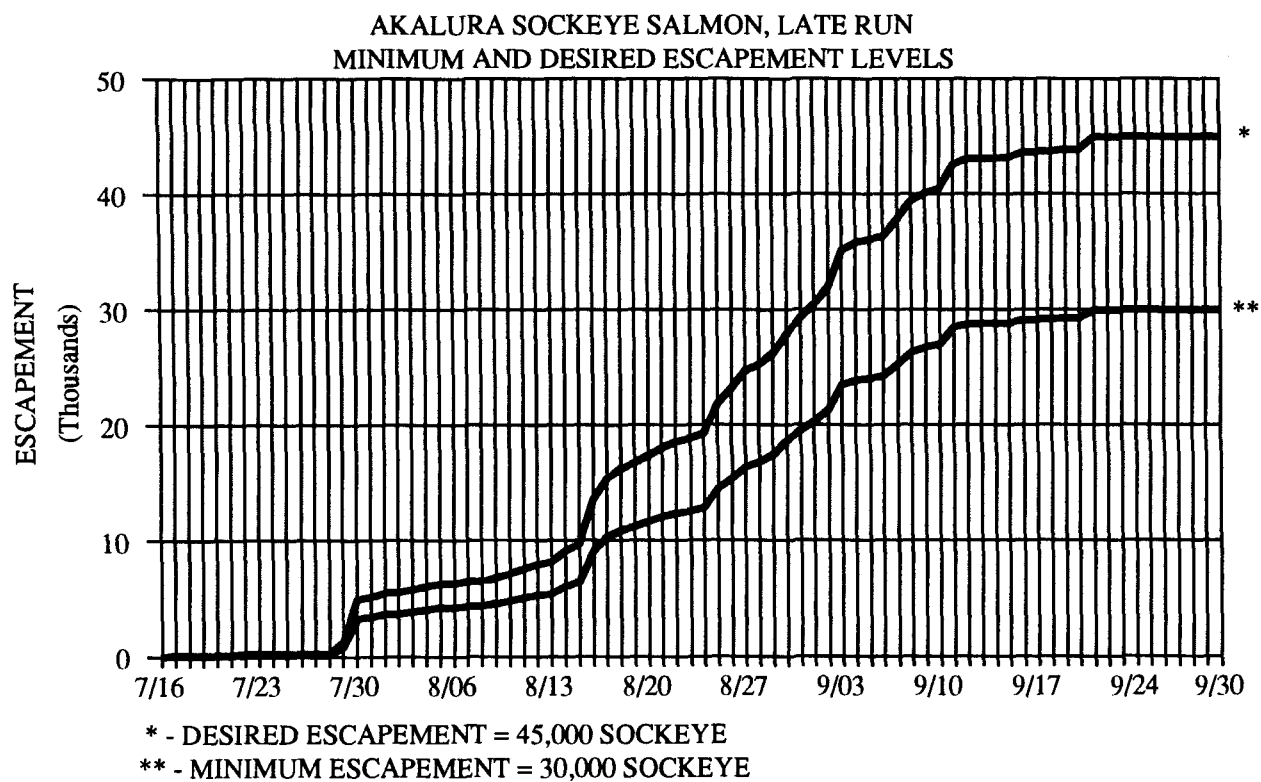
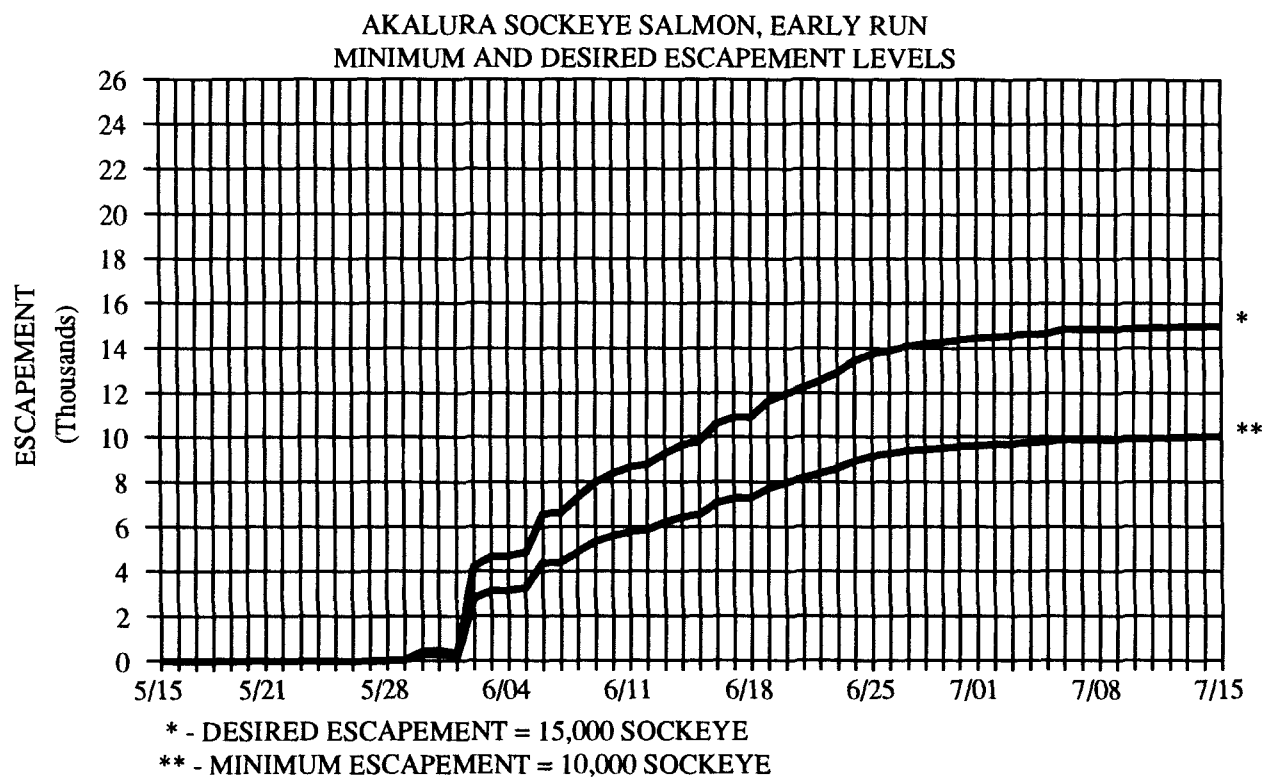
Appendix B.1. Minimum and desired escapement graphs for Karluk sockeye salmon of the Kodiak Management Area, 1993.



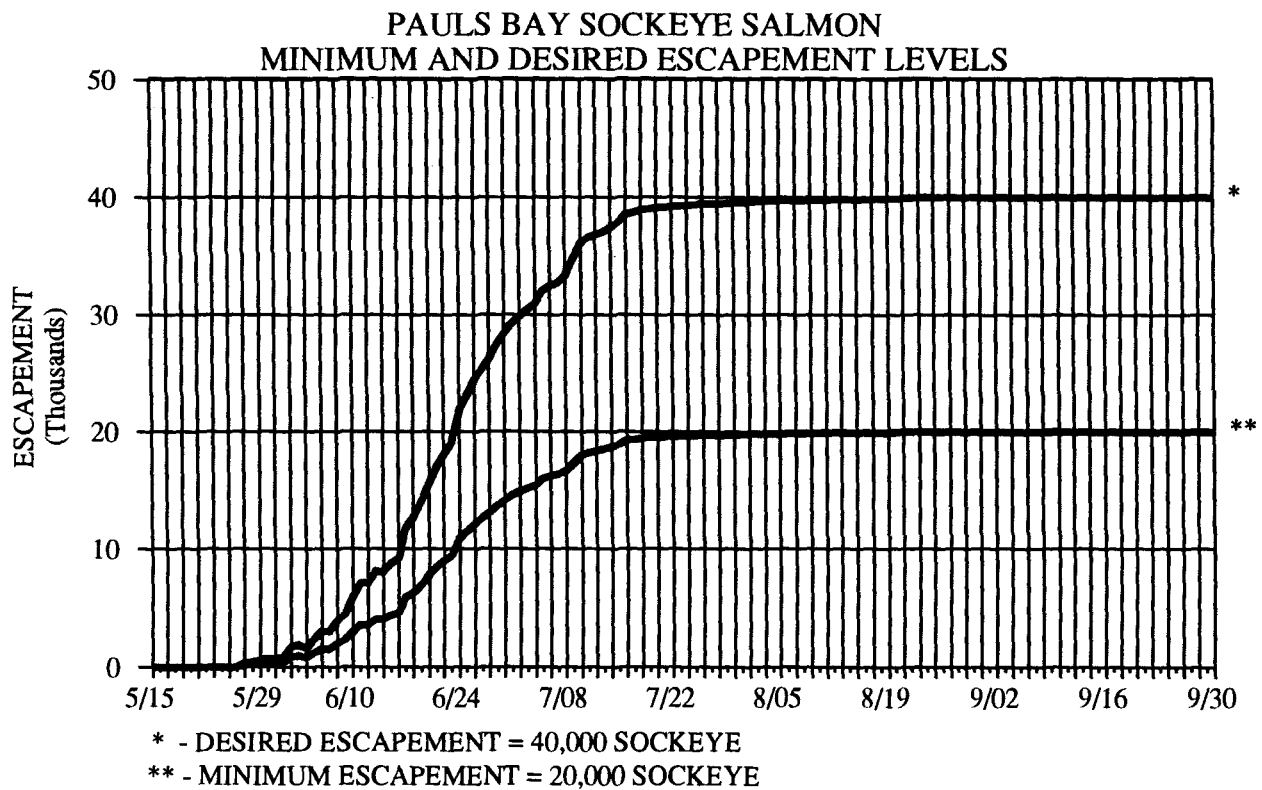
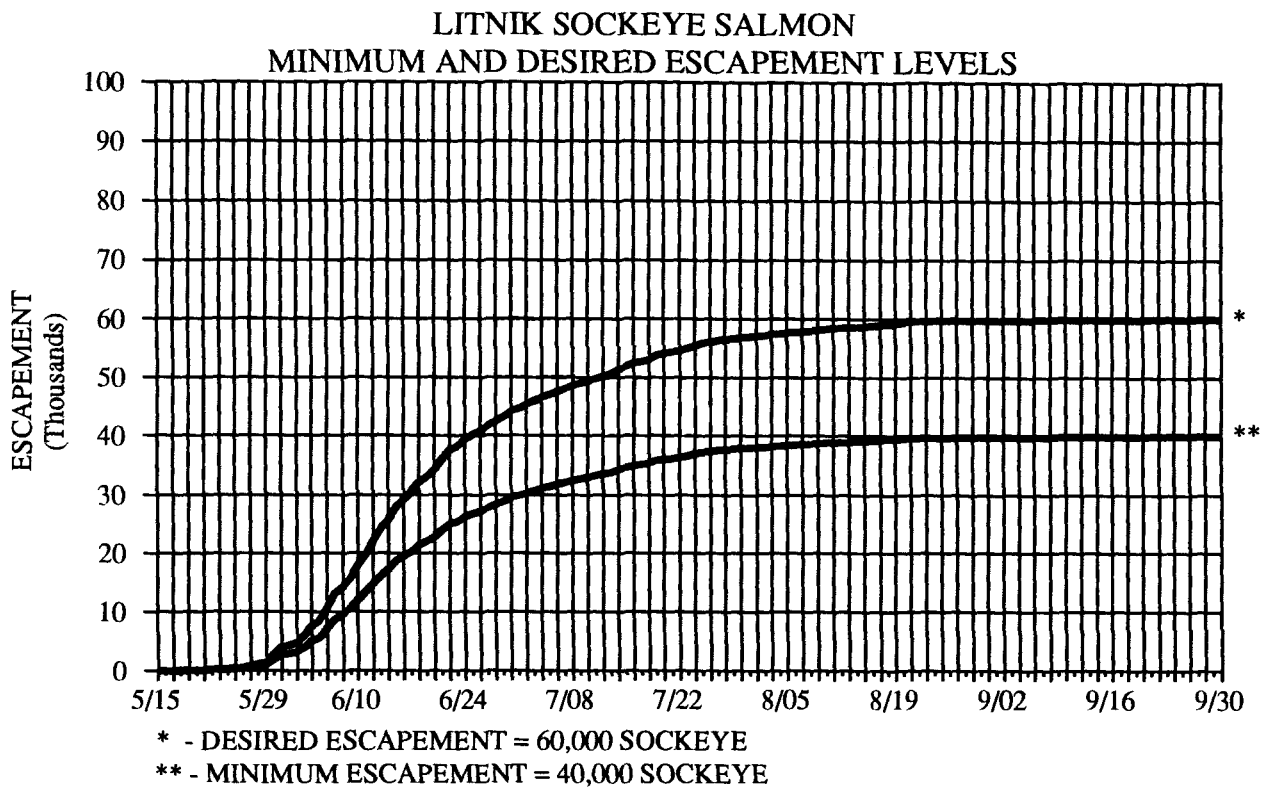
Appendix B.2. Minimum and desired escapement graphs for Ayakulik and Frazer sockeye salmon of the Kodiak Management Area, 1993.



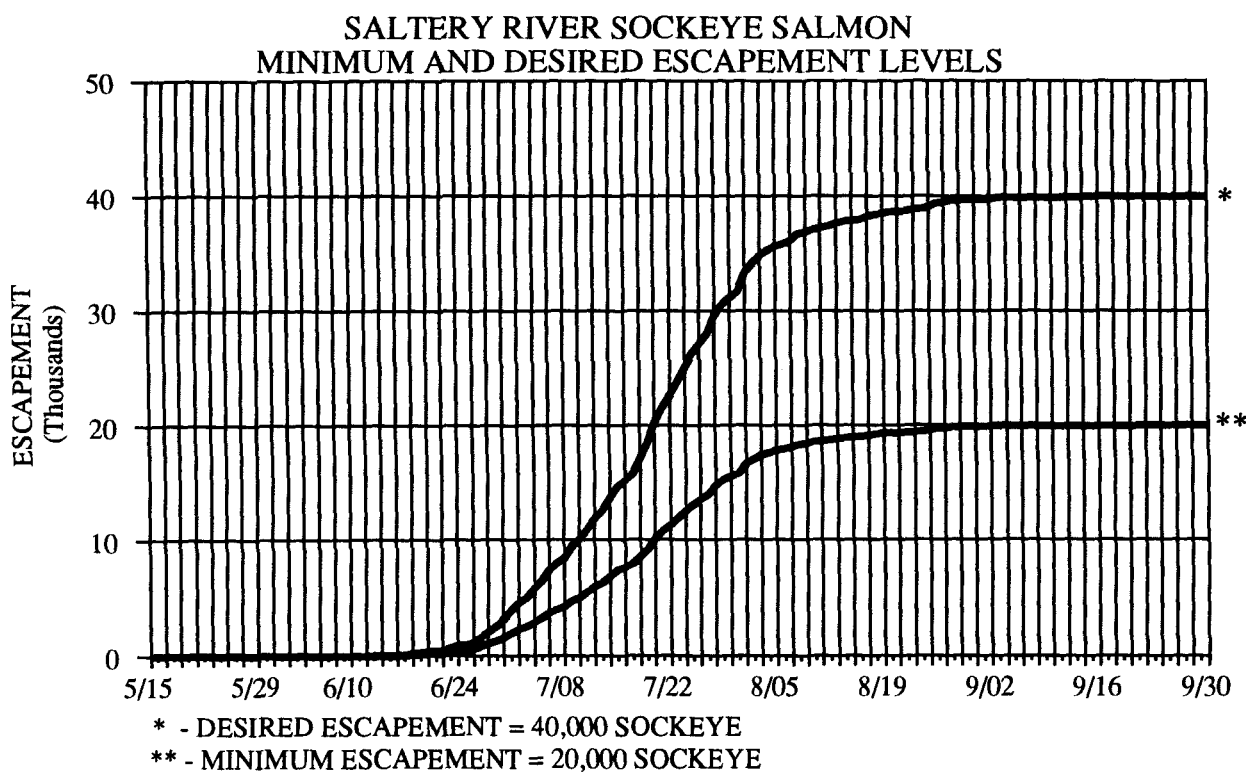
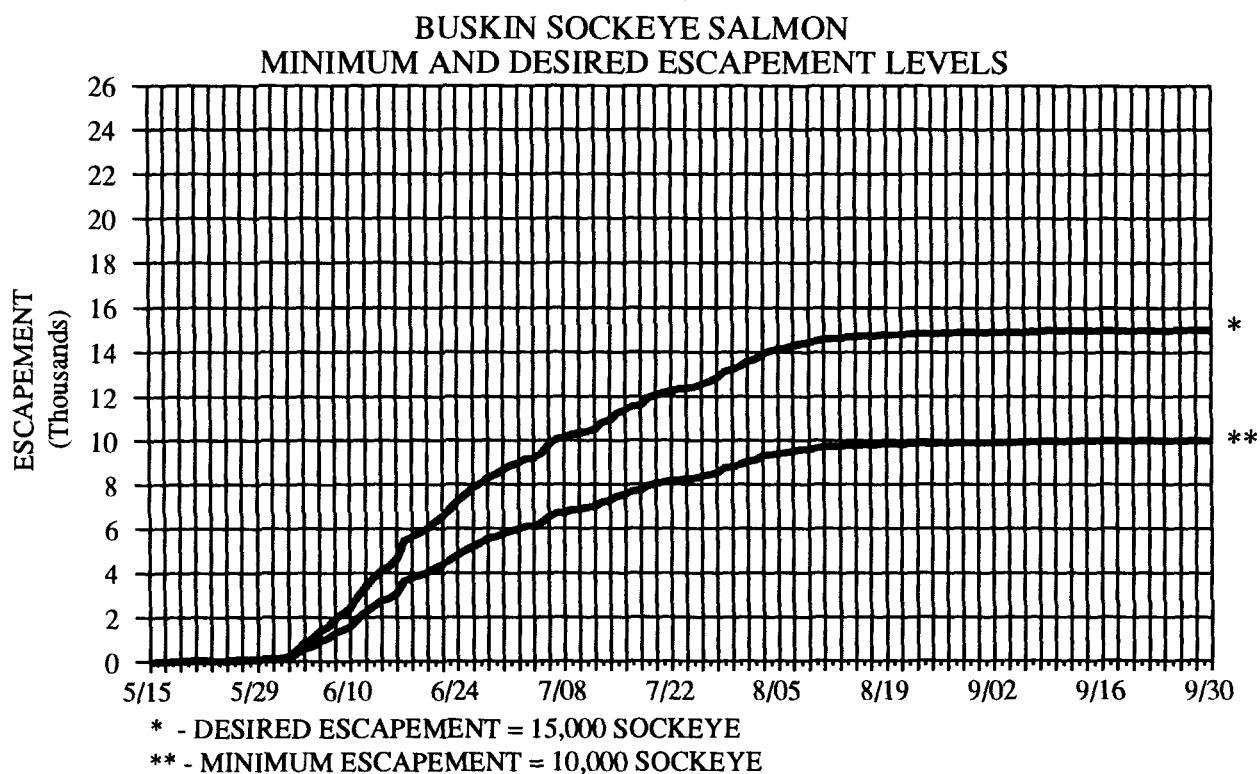
Appendix B.3. Minimum and desired escapement graphs for Upper Station sockeye salmon of the Kodiak Management Area, 1993.



Appendix B.4. Minimum and desired escapement graphs for Akalura sockeye salmon of the Kodiak Management Area, 1993.



Appendix B.5. Minimum and desired escapement graphs for Litnik and Pauls Bay sockeye salmon of the Kodiak Management Area, 1993.



Appendix B.6. Minimum and desired escapement graphs for Buskin and SALTERY sockeye salmon of the Kodiak Management Area, 1993.

OPERATIONAL PLAN
ALITAK BAY JUNE SOCKEYE SALMON
TEST FISHERY FOR 1993



Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska 99615

May 1993

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INTRODUCTION

In the Alitak Bay District of the Kodiak Management Area there are two early sockeye runs, the Upper Station and the Frazer Lake run. Typically, the Frazer Lake run is dominant. Both runs contribute to important west side Kodiak salmon fisheries mainly in the Alitak Bay District in June and early July. A reliable inseason estimate of the early run strength to these systems is necessary to maximize harvest potential and ensure optimum escapement. Currently the primary inseason method for assessing run strength is a combination of the escapement counts at the Dog Salmon and Upper Station weirs, aerial surveys of escapement build-up on the Dog Salmon River flats, and the 9 June Alitak Bay District commercial catch. The information has not always been timely enough to ensure maximum harvest and optimum escapement. An inseason test fishery in conjunction with scale pattern analysis in upper Moser Bay should provide an accurate inseason gauge of the run strength and timing of the Frazer Lake and Upper Station early run stocks.

OBJECTIVES

1. Estimate the daily number of early run sockeye salmon entering Olga Bay.
2. Periodically inseason, estimate the stock origins of the early sockeye run entering Olga Bay.

TASKS

1. Fish a 50-fathom 4 3/4 mesh set gillnet with 120 ft. lead three hours daily at high tide.
2. Sample the test-fish catch for age.
3. Construct a statistical model which provides good classification accuracy for distinguishing Upper Station and Frazer age 1.2 and 2.2 scale patterns.
4. Digitize the age 1.2 and age 2.2 scale patterns of the test-fish catch and Cape Alitak catch samples.

PROCEDURES

Test fishing will be conducted daily from 29 May through 15 July on the northeast side of Chip Cove in upper Moser Bay (Figure 1). A 50 fathom, 40 mesh deep, 4.75 inch stretch mesh gillnet attached to a 120 ft. lead will be fished daily at the location for three hours each day, irrespective to whether a commercial opening is in progress. The daily set will begin on the flood 1.5 hrs. before high tide and end on the ebb 1.5 hrs. after high tide. The sequence will be to fish every other high tide except that there will be no night fishing. When a high tide at night falls within the sequence, the previous high tide will be fished, and the sequence of fishing every other tide will re-start from that tide. Fishing will be discontinued during a set if more than 250 sockeye salmon are in the net. In addition to the catch, associated climatological and fishing conditions will be recorded on the form in Figure 2.

High tide time and height for Chip Cove will be determined using the correction factors for Moser Bay (Time: +0:13; height: x 1.39) as applied to Kodiak tides (Appendix A).

The gillnet used in the test fishery will be maintained in good condition throughout the season. Therefore daily, the gillnet will be inspected, cleaned, and repaired as required to ensure the net is in good fishing condition.

Since the catch is to be sold as food utmost care must be given to ensure product quality. To avoid spoilage and loss of freshness, all catch fish are to be held in ice until delivery except during age sampling.

The catch will be sold to the processor at Alitak. The fish ticket receipts will be issued to the State of Alaska, Department of Fish and Game, Division of Commercial Fisheries, Kodiak. Prior to delivering the catch to the processor, the sockeye salmon will be catch sampled for age (two-scales per fish). Within 24 hours of sampling the scales will be aged.

Linear discriminant analysis using scale measurements will be used to determine rivers origin of the sockeye salmon caught in the test fishery and Alitak District commercial catch. An age 1.2 stock separation model will be developed. The standards will be 200 age-1.2 scales from the 1993 early run Upper Station escapement and 200 age-1.1 scales from the 1992 Frazer Lake escapement. Alternatively, the age 1.2 standards will be developed using age 1.0 smolt samples from the 1991 outmigration. Age-1.2 fish are expected to comprise 17% of the Upper Station and 46% of the Frazer Lake runs in 1993 (Table 1), an age 2.2 stock model will also be developed. The standards will be 200 age 2.1 Upper Station and Frazer Lake scales sampled in the 1992 escapement or alternatively 200 age 2.0 smolt from the respective outmigrations in 1991. Age 2.2 fish are expected to be 63% of the Upper Station and 35% of the Frazer Lake run in 1993. The age specific scale impressions will be projected at 200X onto a digitizing tablet to measure the distances between circuli and record the number of circuli in the first freshwater annulus and the second freshwater annulus. Once these variables are measured, age 1.2 and 2.2 a stock separation models will be constructed that provide high discrimination between Upper

Station and Frazer Lake fish. Inseason the age-1.2 and 2.2 discriminant models will be applied to successive aggregates of 100 (age specific) digitized unknowns from each sample to estimate the Frazer Lake and Upper Station components. All point estimates will be adjusted for misclassification errors using the procedure of Cook and Lord (1978), while 90% confidence intervals around the estimates will be computed using the procedure of Pella and Robertson (1979).

Stock compositions of test and commercial catches other than for the age-1.2 and age 2.2 fish will be estimated by combining the results from the scale pattern analysis with the age composition of the forecasted Upper Station and Frazer Lake runs (Table 1). The underlining assumption will be that the stock composition of the minor ages will be the same as estimated for the age-1.2 and age-2.2 combined. Stock composition estimates based on scale pattern analysis results will be made within 24 hours after the collection of each 100 fish age-1.2 and age 2.2 sample. The latest target date for the first stock composition estimate is 7 June. If a total of 100 or more age-1.2 and age 2.2 fish have not been caught in the test fishery by 5 June and provided the age discriminant models have been developed, test fishing time will be extended on 5 July until the required samples are obtained.

REPORTING

Daily, the catch data will be recorded on a standard form (Figure 2) and also radioed to the Department's Kodiak office via the 3230 frequency. The daily radio report will cover the number of fish caught by species and the total number of minutes fished. Age and stock composition estimates will be transmitted when requested.

Daily test fish catch reports will be posted for the fishermen at Alitak.

LITERATURE CITED

- Cook, R. and G. Lord. 1978. Identification of stocks of Bristol Bay sockeye salmon by evaluating scale patterns with a polynomial discriminant method. U.S. Fish and Wildlife Service, Fisheries Bulletin 76(2): 415-423.
- Fishery, R. 1936. The use of multiple measurements in taxonomic problems. Annual Eugenics 7:179-188.
- Pella. J. and T. Robertson. 1979. Assessment of composition of stock mixtures. Fishery Bulletin 77(2):387-398.

Table 1. Age composition of the 1993 Frazer Lake and early Upper Station sockeye run forecasts.

System	Percent Age Composition				Total Run Number
	1.2	1.3	2.2	2.3	
Frazer Lake	45.9	4.7	35.1	14.4	429,700
Early Upper Station	17.4	6.3	62.7	13.6	98,100

Figure 2. Test fish catch reporting form.

SET NET SITE: _____

YEAR: _____

DATE	FISHING TIME 1/			CATCH			WEATHER 2/								SECCHI DISK (meter)	REMARKS 2/
							TIDE		Wave Height (Ft.)	Wind Dir.	Wind Vel. (mph.)	TEMPERATURE		% Cloud Cover		
	Start	End	Total Min.	Sockeye	Chum	Other	Ht.	Time				Air	Water			

a/ Record to the nearest minute and specify a.m. or p.m.

b/ Use standard tide tables with correction factor for Moser Bay. Record cloud cover to nearest 10%; wave height to nearest foot; wind direction from compass bearing; wind velocity to nearest 5 mph; and temperature to nearest degree.

c/ Note the travel direction for the majority of the fish hitting the net.

APPENDIX A
KODIAK TIDES TABLES

1993 Tides KODIAK District												
HIGH MAY						LOW MAY						
DATE	DOTS	TIME	AM	PM	FT	DATE	DOTS	TIME	AM	PM	FT	FT
1 Sat	•	10:19	6.9	11:09	7.9	4:15	2.1	4:35	0.8			
2 SUN	•	11:35	7.2	11:57	8.8	5:25	1.0	5:30	0.9			
3 Mon	•			12:39	7.5	6:24	-0.2	6:23	0.9			
4 Tues	•	0:44	9.5	1:37	7.7	7:19	-1.2	7:11	1.0			
5 Wed	•	1:27	10.1	2:28	7.9	8:09	-2.0	7:58	1.1			
6 Thur	•	2:11	10.4	3:18	7.9	8:54	-2.4	8:43	1.3			
7 Fri	•	2:55	10.4	4:06	7.7	9:40	-2.4	9:28	1.6			
8 Sat	•	3:39	10.2	4:54	7.4	10:26	-2.1	10:13	1.9			
9 SUN	•	4:22	9.6	5:42	7.1	11:12	-1.6	11:00	2.3			
10 Mon	•	5:07	8.9	6:33	6.8	11:58	-0.9	11:50	2.7			
11 Tues	•	5:53	8.1	7:27	6.6			12:46	-0.2			
12 Wed	•	6:48	7.3	8:23	6.5	0:49	3.1	1:37	0.5			
13 Thur	•	7:51	6.5	9:22	6.6	1:57	3.2	2:31	1.2			
14 Fri	•	9:07	6.0	10:14	6.9	3:16	3.0	3:26	1.6			
15 Sat	•	10:24	5.8	11:01	7.2	4:30	2.5	4:19	1.9			
16 SUN	•	11:30	5.8	11:41	7.7	5:29	1.9	5:10	2.1			
17 Mon	•			12:26	6.0	6:20	1.1	5:55	2.2			
18 Tues	•	0:18	8.1	1:16	6.3	7:00	0.4	6:34	2.2			
19 Wed	•	0:55	8.5	1:57	6.5	7:38	-0.2	7:13	2.2			
20 Thur	•	1:29	8.9	2:39	6.7	8:15	-0.8	7:52	2.2			
21 Fri	•	2:04	9.2	3:17	6.9	8:52	-1.2	8:30	2.3			
22 Sat	•	2:38	9.3	3:56	6.9	9:27	-1.4	9:06	2.3			
23 SUN	•	3:14	9.4	4:34	6.9	10:07	-1.5	9:48	2.4			
24 Mon	•	3:53	9.3	5:16	6.9	10:47	-1.4	10:31	2.5			
25 Tues	•	4:34	9.0	6:03	6.9	11:27	-1.2	11:19	2.6			
26 Wed	•	5:20	8.5	6:51	7.0			12:12	-0.8			
27 Thur	•	6:14	7.9	7:44	7.2	0:19	2.5	12:59	-0.3			
28 Fri	•	7:18	7.2	8:36	7.6	1:26	2.5	1:54	0.3			
29 Sat	•	8:39	6.6	9:35	8.0	2:44	2.1	2:50	0.9			
30 SUN	•	10:00	6.3	10:29	8.6	4:01	1.4	3:50	1.3			
31 Mon	•	11:23	6.3	11:22	9.2	5:13	0.5	4:51	1.7			

AM TIDES • BIGGER THE DOT - BETTER THE FISHING P.M. TIDES
LITE TYPE ALASKA DAYLIGHT TIME BOLD TYPE

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1993 Tides KODIAK District												
HIGH JUNE						LOW JUNE						
DATE	DOTS	TIME	AM	PM	FT	DATE	DOTS	TIME	AM	PM	FT	FT
1 Tues	•			12:31	6.5	6:15	-0.5	5:51	1.9			
2 Wed	•	0:15	9.7	1:32	6.8	7:08	-1.3	6:44	1.9			
3 Thur	•	1:03	10.0	2:24	7.1	7:58	-1.9	7:38	2.0			
4 Fri	•	1:50	10.2	3:14	7.3	8:45	-2.2	8:25	2.0			
5 Sat	•	2:36	10.1	3:57	7.4	9:27	-2.2	9:12	2.0			
6 SUN	•	3:21	9.9	4:41	7.3	10:10	-2.0	9:58	2.2			
7 Mon	•	4:01	9.4	5:24	7.3	10:49	-1.5	10:44	2.3			
8 Tues	•	4:45	8.8	6:06	7.2	11:31	-1.0	11:32	2.5			
9 Wed	•	5:27	8.0	6:48	7.1			12:11	-0.3			
10 Thur	•	6:14	7.2	7:33	7.0	0:25	2.7	12:49	0.4			
11 Fri	•	7:06	6.4	8:19	7.1	1:18	2.8	1:31	1.0			
12 Sat	•	8:07	5.7	9:08	7.2	2:24	2.7	2:13	1.7			
13 SUN	•	9:23	5.3	9:55	7.4	3:34	2.4	3:02	2.2			
14 Mon	•	10:45	5.1	10:45	7.7	4:43	1.8	3:57	2.6			
15 Tues	•	11:54	5.3	11:30	8.1	5:41	1.2	4:53	2.8			
16 Wed	•			12:50	5.6	6:31	0.5	5:46	2.8			
17 Thur	•	0:13	8.5	1:40	6.0	7:13	-0.2	6:36	2.8			
18 Fri	•	0:55	9.0	2:22	6.3	7:54	-0.8	7:23	2.6			
19 Sat	•	1:35	9.3	3:02	6.7	8:33	-1.4	8:06	2.4			
20 SUN	•	2:17	9.6	3:41	7.0	9:12	-1.7	8:51	2.2			
21 Mon	•	2:59	9.7	4:20	7.3	9:51	-1.9	9:37	2.1			
22 Tues	•	3:41	9.6	5:00	7.5	10:28	-1.9	10:23	1.9			
23 Wed	•	4:26	9.3	5:40	7.8	11:09	-1.6	11:15	1.8			
24 Thur	•	5:15	8.7	6:22	8.0	11:48	-1.2					
25 Fri	•	6:07	7.9	7:10	8.2	0:11	1.7	12:33	-0.4			
26 Sat	•	7:07	7.0	8:00	8.4	1:15	1.5	1:20	0.4			
27 SUN	•	8:23	6.2	8:57	8.6	2:26	1.3	2:11	1.2			
28 Mon	•	9:47	5.7	9:57	8.8	3:44	0.9	3:13	1.9			
29 Tues	•	11:14	5.6	10:58	9.1	4:58	0.2	4:19	2.4			
30 Wed	•	12:28	5.9	11:54	9.4	6:03	-0.4	5:28	2.6			

AM TIDES • BIGGER THE DOT - BETTER THE FISHING P.M. TIDES
LITE TYPE ALASKA DAYLIGHT TIME BOLD TYPE

73

1993 Tides KODIAK District												
HIGH JULY						LOW JULY						
DATE	DOTS	TIME	AM	PM	FT	DATE	DOTS	TIME	AM	PM	FT	FT
1 Thur	•			1:27	6.3	7:00	-1.1	6:28	2.5			
2 Fri	•	0:50	9.6	2:17	6.7	7:50	-1.5	7:23	2.4			
3 Sat	•	1:38	9.8	3:01	7.0	8:33	-1.8	8:14	2.2			
4 SUN	•	2:24	9.7	3:41	7.3	9:14	-1.8	9:00	2.0			
5 Mon	•	3:06	9.5	4:20	7.5	9:52	-1.6	9:42	2.0			
6 Tues	•	3:45	9.2	4:55	7.6	10:24	-1.3	10:23	2.0			
7 Wed	•	4:23	8.6	5:29	7.6	11:00	-0.8	11:05	2.0			
8 Thur	•	5:03	8.0	6:04	7.5	11:32	-0.3	11:50	2.1			
9 Fri	•	5:40	7.2	6:38	7.5			12:04	0.4			
10 Sat	•	6:25	6.5	7:18	7.5	0:38	2.2	12:35	1.1			
11 SUN	•	7:18	5.7	7:57	7.4	1:32	2.2	1:10	1.7			
12 Mon	•	8:24	5.1	8:50	7.5	2:37	2.1	1:55	2.3			
13 Tues	•	9:48	4.7	9:43	7.6	3:50	1.9	2:48	2.8			
14 Wed	•	11:17	4.8	10:41	7.9	4:59	1.4	3:53	3.1			
15 Thur	•	12:26	5.2	11:35	8.4	5:58	0.7	5:04	3.2			
16 Fri	•			1:16	5.7	6:47	-0.1	6:05	3.0			
17 Sat	•	0:28	8.9	1:58	6.3	7:31	-0.8	6:58	2.6			
18 SUN	•	1:16	9.4	2:37	6.9	8:12	-1.4	7:49	2.1			
19 Mon	•	2:01	9.8	3:15	7.4	8:49	-1.8	8:36	1.6			
20 Tues	•	2:45	9.9	3:51	7.9	9:27	-2.0	9:24	1.2			
21 Wed	•	3:30	9.8	4:30	8.4	10:06	-1.9	10:12	0.8			
22 Thur	•	4:16	9.4	5:09	8.7	10:43	-1.5	11:03	0.6			
23 Fri	•	5:03	8.7	5:50	8.9	11:24	-0.9	11:58	0.5			
24 Sat	•	5:58	7.8	6:35	8.9			12:04	0.0			
25 SUN	•	6:57	6.8	7:26	8.8	0:57	0.6	12:50	0.9			
26 Mon	•	8:12	5.9	8:23	8.7	2:07	0.7	1:39	1.7			
27 Tues	•	9:39	5.3	9:30	8.6	3:23	0.6	2:44	2.5			
28 Wed	•	11:10	5.3	10:40	8.7	4:45	0.3	4:00	2.9			
29 Thur	•	12:24	5.7	11:44	8.8	5:55	-0.2	5:17	3.0			
30 Fri	•			1:21	6.2	6:52	-0.6	6:22	2.7			
31 Sat	•	0:40	9.1	2:04	6.7	7:38	-1.0	7:17	2.3			

AM TIDES • BIGGER THE DOT - BETTER THE FISHING P.M. TIDES
LITE TYPE ALASKA DAYLIGHT TIME BOLD TYPE

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Appendix A.1. Standard tide tables for Kodiak District, 1993.

**OPERATIONAL PLAN
UPPER STATION AND RED LAKES
SCKEYE SMOLT STUDIES, 1993**



**Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska 99615**

APRIL 1993

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INTRODUCTION

In 1989 the commercial sockeye salmon (*Oncorhynchus nerka*) fisheries were curtailed in most of the Kodiak Management Area due to oil contamination from the 24 March 1989 EXXON VALDEZ spill. As a consequence several sockeye systems had excessive escapements. For example, the Red Lake system where the escapement objective is 200,000 to 300,000 fish had a 770,000 escapement. There is concern that the large escapements may damage future returns by a combination of factors in the freshwater environment including disease, fry starvation, and shifts in the plankton community caused by excessive predation. The project covered here addresses sockeye smolt production.

Goal

The goal is to determine whether smolt production has been impacted due to surplus sockeye escapement in 1989 at Red Lake using Upper Station Lake as a control. Specific objectives and tasks are:

Objectives

1. Estimate the total number of outmigrant smolt by age class;
2. Estimate smolt age composition and average smolt weight, length, and condition factor by age class;
3. Estimate the outmigration timing of the smolt by age class.
4. Estimate seasonal use of nearshore areas of Red Lake by young-of-year sockeye salmon fry.

Tasks

1. Operate a Canadian fan trap continuously through the smolt migration;
2. Quantify the daily catch by species;
3. Sample 70 sockeye smolt per day, five days each week, for age, length, and weight through the migration;
4. One day each week, mark and release 500 sockeye smolt using Bismark Brown Y dye approximately 0.5 miles upstream of the index trap to determine trap efficiency;
5. At Red Lake, using a fifty foot seine, weekly sample four field selected lake shoal areas to index sockeye salmon fry abundance and growth.

SUPERVISION

The field staff and crew leaders are:

Upper Station	Cris Hicks	- Crew Leader
	Jeff Wadle	- Crew
Red Lake	Ken Bouwens	- Crew Leader
	Jon Pope	- Crew
	Bruce MacIntosh	- Crew

The crew leaders are responsible for making daily work assignments and ensuring that operations are conducted safely and according to the standards defined in this manual. It is also the crew leaders responsibility for making sure that all crew members have read and understand the Department's field safety policy and have signed the EMPLOYEE SAFETY SOP VERIFICATION. Swanton, Barrett, and Roche will administratively oversee the program which will include ensuring that adequate logistic, equipment, and technical support are provided.

PROCEDURES

Trap Location, Set-up, and Maintenance

A Canadian fan trap will be operated at Upper Station located in the outlet stream of Lower Upper Station Lake about 1/2 mile below the lake. At Red Lake, two traps will be fished in the outlet creek one mile below the lake. All traps are to be operating by 5 May 1993. Generally each trap will be situated mid channel and at the tail of a riffle where velocity (>1 ft/sec) and depth (>1 ft.) are sufficient for enough flow through the trap to minimize fish avoidance problems. Depending on the flow conditions and size of the trap aperture, perforated smolt panels may be used for leads to enhance trap efficiency. After the initial set-up and evaluation, if a trap is repositioned or lead material is added or deleted, the action should be well documented in the comment section of the Daily Catch Reporting Form (Figure 1). This is important because of the likely change in the gear efficiency.

Each trap will be checked as often as necessary to maintain the trap efficiency and minimize any fish mortalities. Minimally, the traps should be checked every 30 minutes between the hours of sunset and sunrise. During daylight hours a check once every four hours is usually adequate. The last trap check will be at the conclusion of the smolt day (approximately 11:55 a.m.). Although smolt generally outmigrate in the evening hours, there is evidence of large smolt movements occurring in hours of mid afternoon coinciding with major weather changes including rain storms. It is essential that each crew keep a close vigilance on the assigned smolt trap. Unfortunately there are numerous instances where crew vigilance has been less than desirable and thousands of smolts have been overcrowded and killed solely due to crew inattentiveness.

Quantification and Species Identification of Trap Catch

There are two methods for determining the number of fish caught in a trap by species. The simplest and most common procedure is to individually count the fish by species while emptying the live box with a dip net. Alternately, the catch is transferred by dip net into a partially water filled 5-gallon plastic bucket and the fish are individually counted in the process of spilling the contents of the bucket in the stream below the trap. This number will be recorded on the Daily Smolt Catch Reporting Form (Figure 1.). The second method involves a catch-weight sampling procedure where the catch is transferred by dip net into a small mesh netted basket suspended over the creek from a hanging scale. The aggregate weight of the catch is then recorded and the process is continued until the live box is emptied (Figure 2.). During the catch-weight sampling process, samples are taken to determine species count by weight. This involves counting the number of fish by species from a known aggregate weight obtained using a hanging scale. Generally the rule will be to sample every tenth dip net of fish for a species count by weight. The second method should only be used when there are relatively large numbers of smolt being caught, and there is not enough time to count all the fish without incurring mortalities. It should be noted in the comments section of the daily smolt reporting form when the catch weight method is used. The last daily smolt count will occur at @ 11:55 a.m completing the daily smolt enumeration. The daily total will be recorded on the Sockeye Salmon Smolt Summary Form (Figure 3).

All catch will be identified and counted by species. Species identification keys are provided in Appendix A. It will be the responsibility of the crew leaders to insure that the crews use the keys to properly identify the catch.

Trap Efficiency

Once a week, trap efficiency will be estimated by marking sockeye smolt, releasing these smolt, and counting the number of recaptured smolt. Marking is accomplished by the use of Bismark Brown Y dye. The dyeing process can be stressful on sockeye smolt. This is important to keep in mind at all times during the procedure. Minimizing unnecessary stress is the key in the dyeing process. Excessive handling (netting), elevated water temperature, and exposure to the dye itself, are the primary stress factors. All of these can induce mortality alone, so if one or more of these are combined, significant mortality may occur. The following steps should be followed to minimize mortality and assure valid results:

1. **Collect 500 to 525 sockeye smolt.** The goal is to be consistent in the weekly timing and number of our marking and release. Do not hold smolt for more than three nights when trying to collect the 500 for marking. Mark what you have collected after three days. A minimum of 250 smolt should be used if an extended collection time is required. Record the time, water temperature, and number of smolt collected on the Smolt Dye Release Form (Figure 4.).
2. **Set up dyeing station at release site.** The release site will be no less than 0.5 miles upstream of smolt trap in an area of relatively calm water. A holding box will be placed

in the stream, preferably in a "pool" area, for initial release of marked smolt. Assemble other marking equipment: 30 gallon garbage can or tote, Bismark Brown Y dye, supplemental oxygen (O₂ bottle, regulator, tubing, air stone), aerators, thermometer, log book.

3. **Move smolt to release site.** Use 3 buckets to hold the smolt. An aerator will be used to aerate the water in each bucket. Split the 500 smolt between the three buckets. It is important to be efficient when moving the smolt to the release site. Record the water temperature prior to transport to the release site.
4. **Dye and release smolt.** Upon reaching the release site, hold the smolt in a live box or tote anchored in the stream for a minimum of 30 minutes. Record the water temperature at the start of the recovery period and any mortality at the end of the recovery period. If the stream temperature is $> 8^{\circ}\text{C}$ or there are obvious signs of stress, oxygenate the water using the portable aerators and/or oxygen bottle. For dyeing the smolt, use 1 gram of BBY dye per 30 liters (8 gallons) of water. Mix water (15 gallons) and dye (1.9g) in a 30 gallon container. Use an aerator and supplemental oxygen to maintain oxygen level. Record the water temperature in the dye container. Using a dipnet, place the smolt into dye/water mixture for 30 minutes. Keep the dye container (with the lid on) in the stream to maintain ambient water temperature. Record any mortality that occurs. After the smolt are dyed, place them into the instream holding box for one hour. After a 60 minute recovery period, remove and document any mortality or weak appearing smolt. Transfer only the robust smolt to water filled buckets and release them evenly across the stream. Record the number of healthy smolt released, time of release, water temperatures and other data on the Smolt Dye Release Form (Figure 4). All sick and dead smolt will be disposed of in a manner which will not attract animals or influence trap catches.
5. **Examine for marked smolt.** For three days (which includes 3 nights) following the release of dyed smolt, daily smolt catch (all fish if physically possible) will be examined for marked fish. The first day of smolt examination is the day of release. The last smolt examination will occur on the 3rd day after release at 11:55 am. Trap efficiency is measured by the number of marked fish recovered. Record mark recapture data on the Daily Smolt Catch Reporting Form (Figure 1) and summarize the data on the Sockeye Salmon Smolt Summary Form (Figure 3). Remember that the number of smolt examined in a day equals marked and non-marked smolt caught that day. Daily smolt catch will then equal the number examined minus the number marked since marked smolt were previously counted.

Age, Weight, and Length Sampling

At each location, 70 sockeye smolt per day, five days per week, are to be sampled for age, length, and weight. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. Specific procedures for collecting and recording the information is in Appendix B. Each sample will be taken from a single days catch. Do not mix samples between days. If less than 70 fish are caught in a day, the sample size for that day will be the number

of fish caught on that day. Since smolt primarily migrate at night, a single sampling day will be the 24-h period from noon to noon and will be identified by the calendar date corresponding to the first noon.

Otolith Collection

At Red Lake, 300 smolt will be taken for otolith analysis. As possible, these smolt are to be collected proportional to outmigrating abundance. Ninety percent ethanol is to be used for preservative. The procedure for collection is straight forward. Simply take a fish (randomly) that has been captured in the trap, sample it for standard AWL data, and then put it into an individual polybottle filled with 90% ethanol. Take care to accurately label the bottle with the following information: the origin of capture, date, AWL sheet #, and fish reference #. Additionally, include the same information on a piece of write-in-the-rain paper and place it in the bottle with the fish. The percentage of preservative to fish is critical. Each bottle should be filled to the top with straight 90% ethanol.

Red Lake Fry Sampling

Weekly, sample four field selected shoal areas using a 50-ft length beach seine. At each location, the catch will be sorted and counted by species, and lengths will be taken only on sockeye salmon, Dolly Varden, coho salmon, and rainbow trout. Data will be recorded on the Seine Catch Log Form (Figure 5). The site locations were marked in 1992 by placement of a metal fence post on the shore at each site. The approximate location is identified in Figure 6.

Climate Data

Climatological data will be collected at each location daily at approximately 1800 hrs. The information will be recorded on the Climatological Observation Form and will include water and air temperatures (C), stream height (cm), percent cloud cover, and wind direction and velocity (Figure 7.).

PROJECT TERMINATION

The smolt traps at Red Lake will be removed at the end of the smolt migration which is expected to be about 30 June. At Upper Station, smolt monitoring will continue through about 5 August to ensure that the age 0 smolt migration is evaluated. The exact date for removal of traps will be determined by Barrett and/or Swanton based on trap catch rate performance.

Figure 1.

DAILY SMOLT CATCH REPORTING FORM

TRAP NUMBER	PROJECT LOCATION	DATE
_____	_____	_____

TIME (MILITARY)	SOCKEYE SMOLT (numbers)			OTHER (numbers)			COMMENTS 2/
	CATCH 1/	EXAMINED FOR MARKS	MARKED RECOVERIES	COHO	DOLLY V.	STICKLEB.	
TOTAL							

1/ Catch number does not include marked recoveries.

2/ To be included in comments: estimate young-of-year fry numbers by species and number of sockeye smolt mortalities.

Figure 2. Catch-weight sampling form (work sheet for estimating smolt trap catch).

Date: _____ Time Period (military): _____ to _____ Project Location: _____

Basket Weight (wet): _____

Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)	Basket #	Weight (fish + basket)
1.		11.		21.		31.	
2.		12.		22.		32.	
3.		13.		23.		33.	
4.		14.		24.		34.	
5.		15.		25.		35.	
6.		16.		26.		36.	
7.		17.		27.		37.	
8.		18.		28.		38.	
9.		19.		29.		39.	
10.		20.		30.		40.	
TOTAL:		TOTAL:		TOTAL:		TOTAL:	
GRAND TOTAL _____ LESS BASKET WEIGHTS _____ = _____ (a)							

Sample Biomass (Fish plus basket weight)	CATCH	
	Sockeye Smolt	Other
1.		
2.		
3.		
4.		
5.		
TOTAL:	(c)	(d)
GRAND TOTAL _____ LESS BASKET WEIGHTS _____ = _____ (b)		

ESTIMATED CATCH: _____ SMOLT (ac/b); _____ OTHER (ad/b)

SOCKEYE SALMON SMOLT SUMMARY FORM

TRAP NUMBER:

[illegible]

- 1/ Each date covers a 24-hour period extending from noon to noon and identifies the starting date.
- 2/ Numbers of fish caught does not include marked recoveries.
- 3/ Marked recoveries are not included in the catch because they represent previously caught smolt.

Figure 4.

SMOLT DYE RELEASE FORM

DATE (actual): _____

CREW NAMES (print) _____

PROJECT LOCATION _____

NUMBER OF FISH COLLECTED: _____
(from live box)

CREW LEADER
(signature) _____

	COLLECTION LIVE BOX	TRANSPORT BUCKET	RECOVERY CONTAINER	DYE TUB	RECOVERY CONTAINER	TRANSPORT BUCKET	STREAM RELEASE
START TIME (military)							
START TEMP (degree celsius)							
END MORTALITY (number of fish)							
OXYGEN SUPPLEMENT O2 or aerator (A)							

DYE SOLUTION (mixture): Dye (grams)= Water (gallons)=

RELEASE SITE LOCATION (distance upstream of trap site, in miles) _____

TOTAL NUMBER OF DYED FISH RELEASED: _____

COMMENTS:

Figure 5. Seine catch log form.

Lake: _____ Time: _____ Remarks: _____

Date: _____ H₂O temp: _____

Location: _____

Seine length: _____ Crew: _____

TOTAL CATCH					
SOCKEYE	COHO	DOLLY V.	STICKLEBACK	RAINBOW	OTHER

	LENGTH SAMPLE			
	SOCKEYE	COHO	DOLLY V.	RAINBOW
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
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14				
15				
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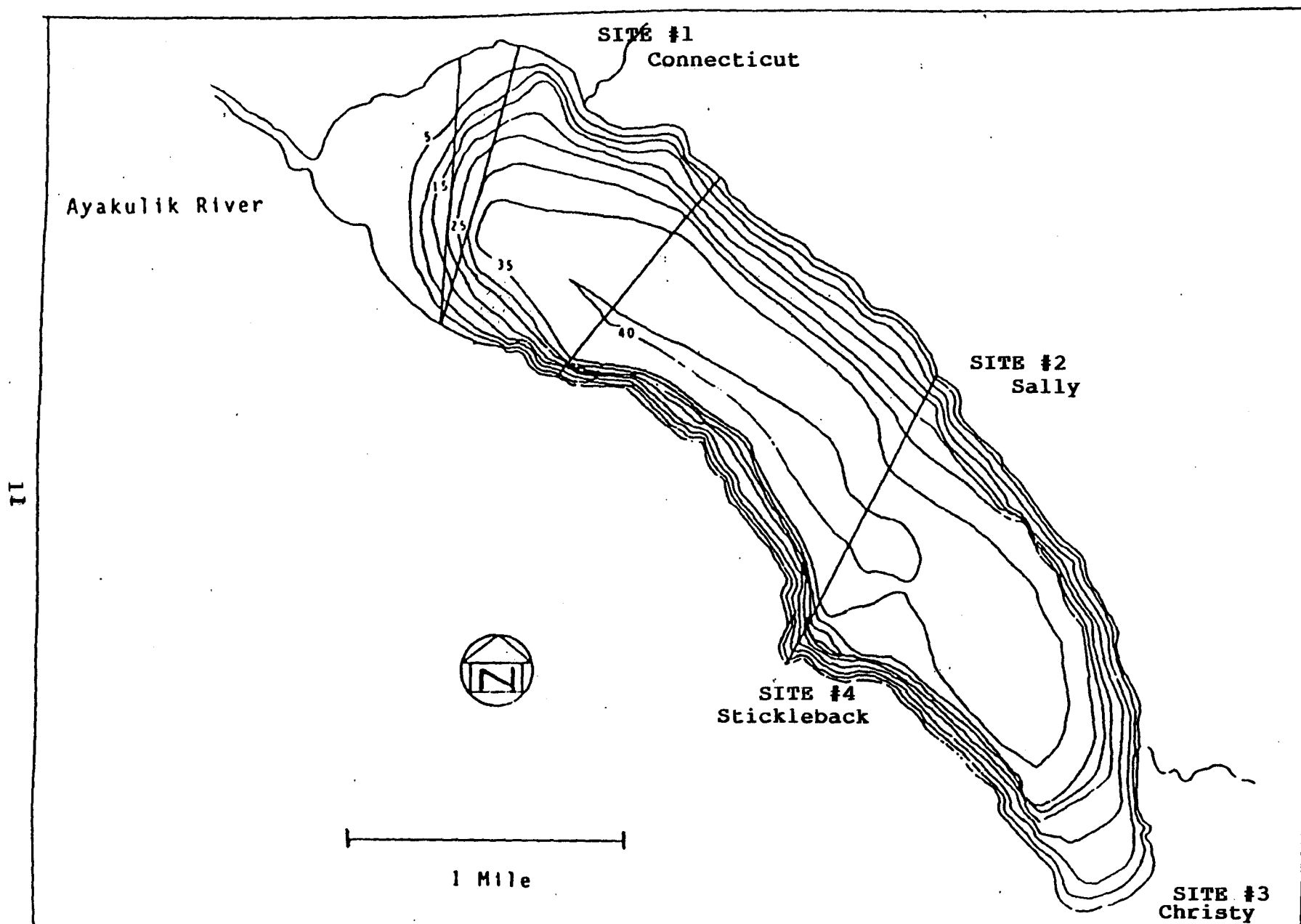


Figure 6. Morphometric map of Red Lake on Kodiak Island.

Figure 7.

CLIMATOLOGICAL OBSERVATIONS

PROJECT LOCATION: _____

DATE	TIME	TEMPERATURE		CLOUD COVER (%)	WIND		STREAM GAUGE (0.1 FT)	COMMENTS
		AIR (°C)	WATER (°C)		DIRECTION	VEL. (MPH)		

APPENDIX A

Presmolt Salmon Key
and
Anadromous Juvenile Salmonides Key

A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN¹

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species² of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky³). In addition to

the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

¹ Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service, Auke Bay Fisheries Laboratory during the summers of 1959 and 1961. The specimens were obtained and most of the drawings made at that time.

² A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

³ N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently),

leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such as

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream*: estimate its average width and maximum depth; if tidal and brackish, to what

extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay*: state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

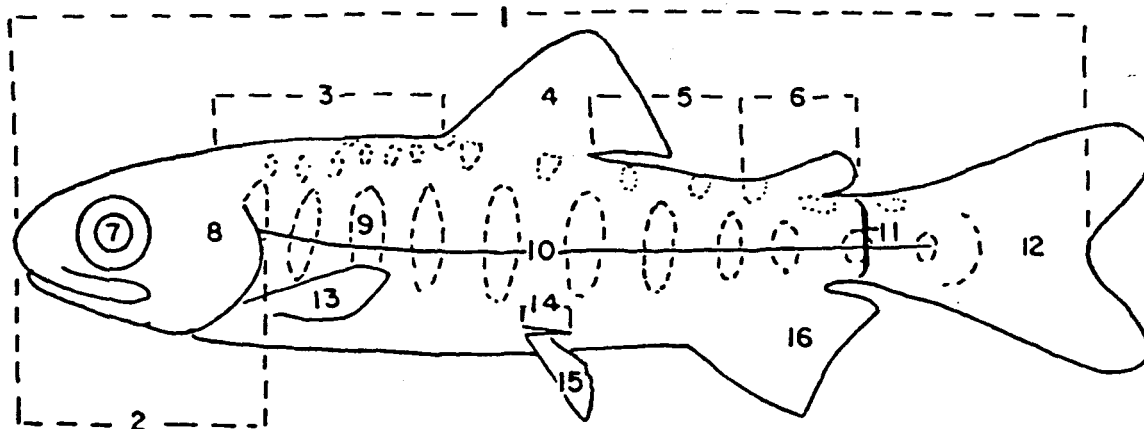
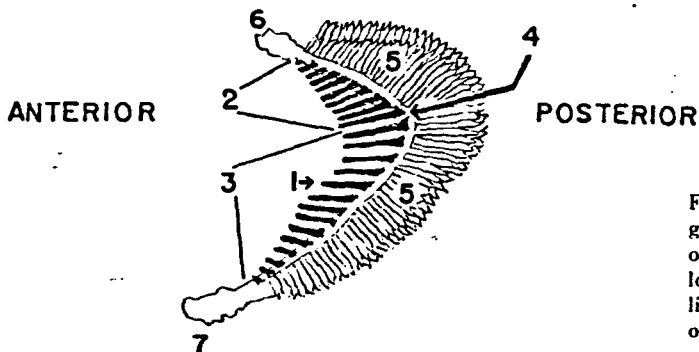


Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1: fork length; 2: head length; 3: predorsal ridge; 4: dorsal fin; 5: portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6: adipose fin; 7: pupil of eye; 8: gill cover, beneath which is gill chamber containing gill arches; 9: a parr mark; 10: lateral line; 11: caudal peduncle; 12: caudal fin or tail; 13: pectoral fin; 14: axillary process or scale; 15: pelvic fin; 16: anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches; the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined



at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given; otherwise, both limbs are recorded separately (the upper limb first), and then added, thus $12 + 20 = 32$.

The gill rakers nearest the angle of the arch are the longest; the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch up-

ward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

Figure 2.—First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

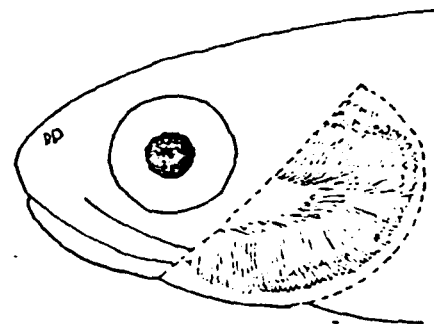


Figure 3.—Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

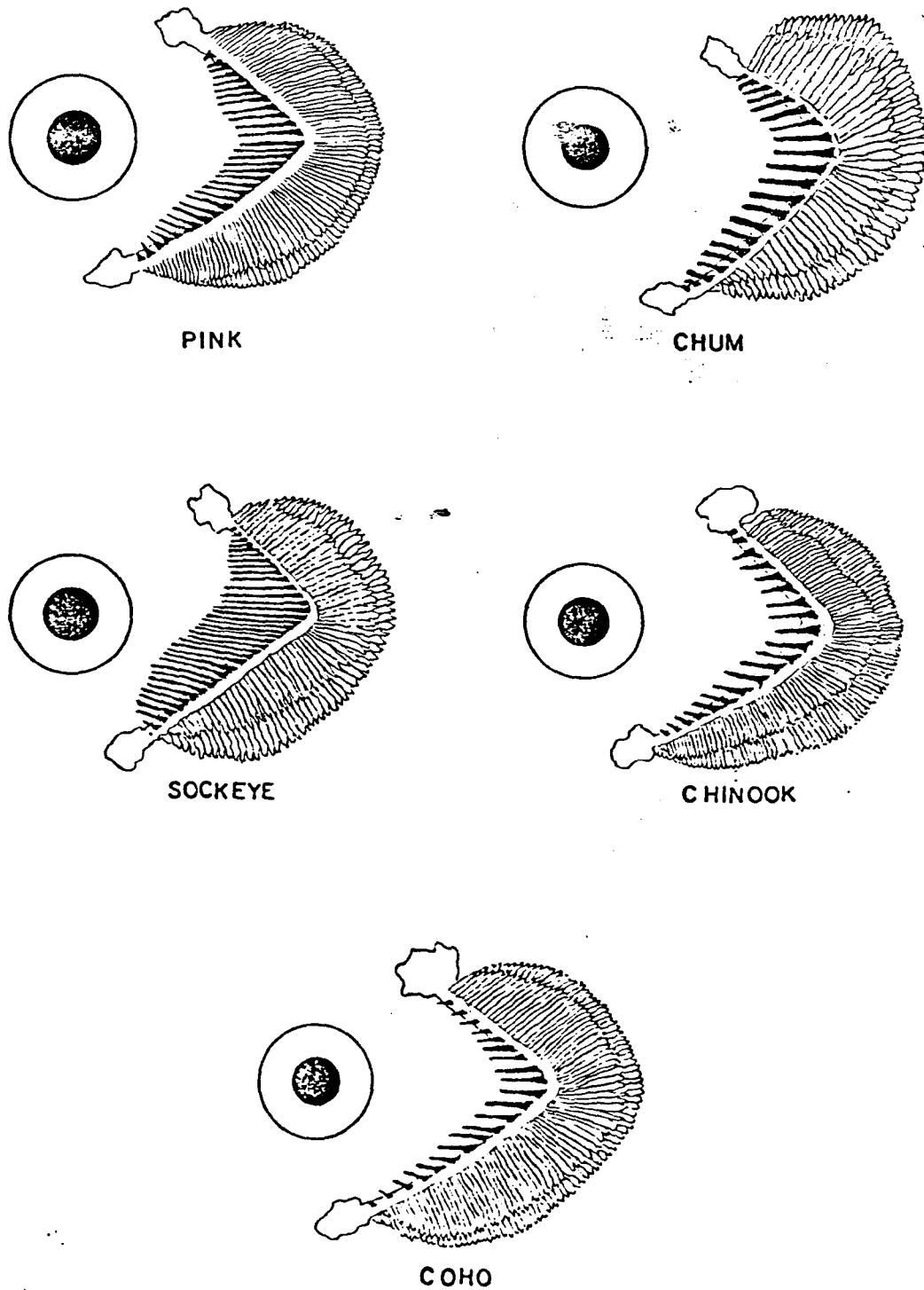


Figure 4. — First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

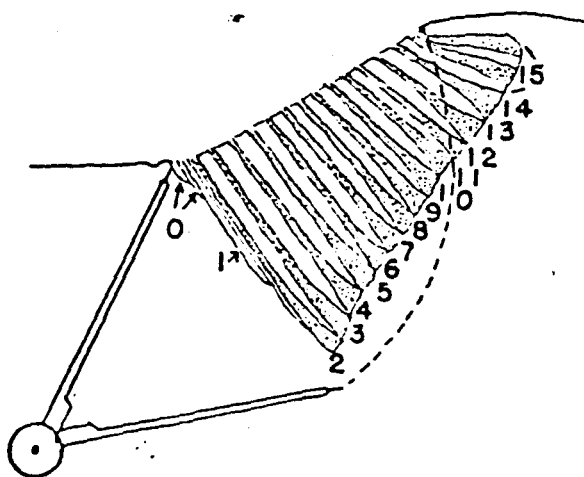


Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

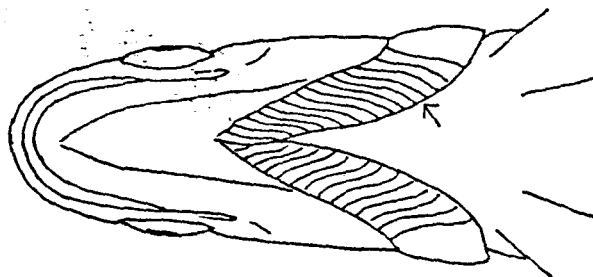


Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count⁴

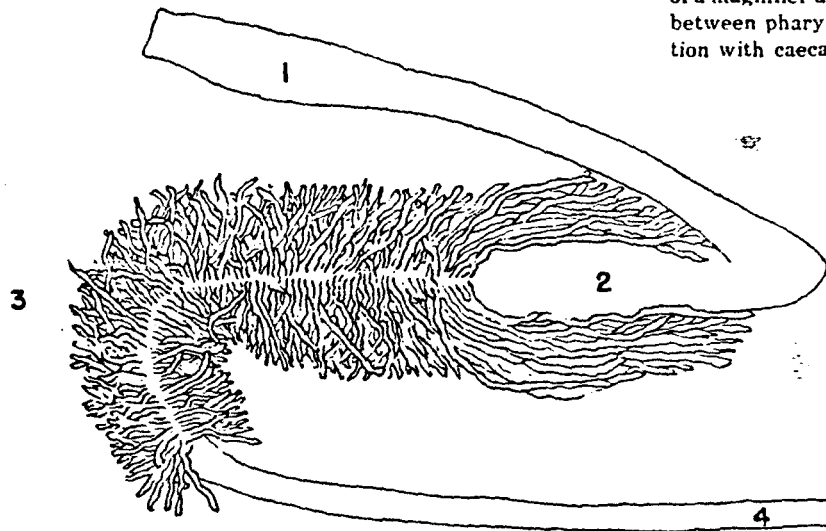
With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluish-

⁴In the key, I have used pyloric caeca counts of my own, plus published accounts of others and especially the more recent ones, such as Clemens and Wilby (1961) and McPhail and Lindsey (1970).

Figure 7. — Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.



or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of

the same species may lose parr and other presmolt markings when only half as large as other fish.

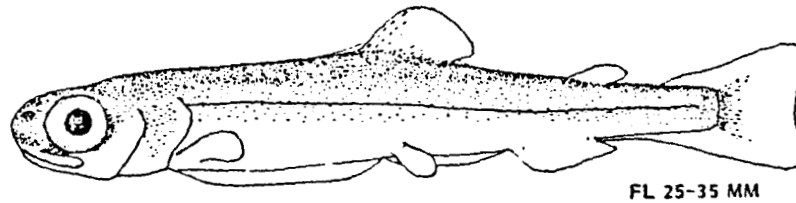
HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

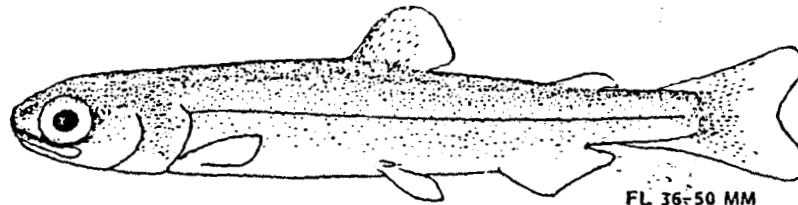
In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections "Combination of" under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections "Combination of" under groups 4; if present, see "Combination of" sections under groups 5. Decide which "Combination of" most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

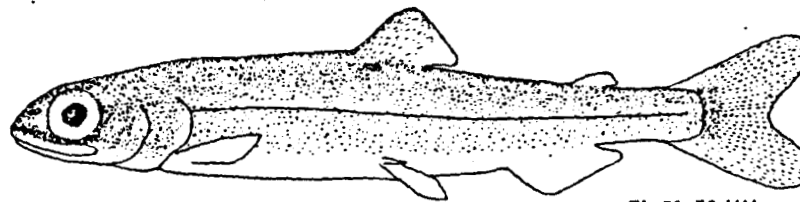
- Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes grayling); strong teeth on jaws and tongue (excludes ciscoes and whitefishes); many pyloric caeca (excludes smelts, family Osmeridae); an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14); an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary1.
- Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal fin of larger juveniles of some species with several blackish spots.
- 1a CHAR, TROUTS, ATLANTIC SALMON.Not in this key.
- Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal fin of larger juveniles lack blackish spots but tip of fin may be blackish.
- 1b PACIFIC SALMON—genus *Oncorhynchus*.2.
- Combination of: No parr marks on sides and no prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melanophores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.
- 2a PINK (HUMPBACK) SALMON—*O. gorbuscha*.Plate 1.
- General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.
- Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.
- Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.
- Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.



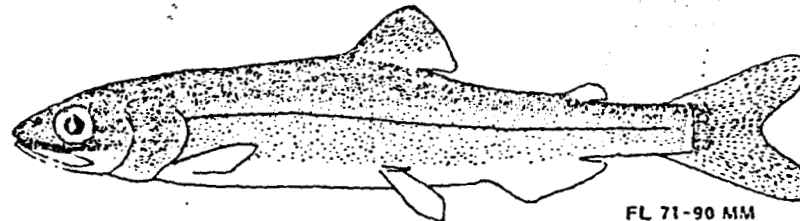
FL 25-35 MM



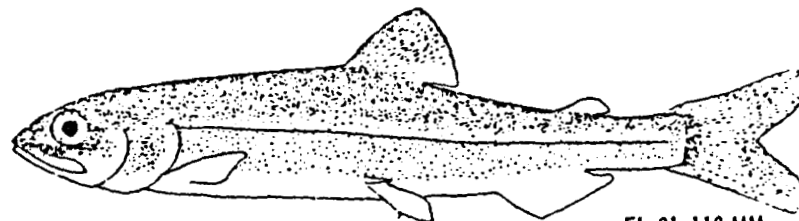
FL 36-50 MM



FL 51-70 MM



FL 71-90 MM



FL 91-110 MM

Plate 1.—Pink salmon.

- Gill rakers (see Fig. 4) — Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).
- Pyloric caeca — Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.
- Branchiostegal rays — Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).
- Scales in lateral line — More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.
- Habits — Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.
- Combination of:* Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnification (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration 3.
- 2b
- No melanophores normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.
- 3a
- CHUM AND SOCKEYE SALMON 4.
- Melanophores normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.
- 3b
- CHINOOK AND COHO SALMON 5.
- Combination of:* Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally no melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.
- 4a
- CHUM (DOG) SALMON — *O. keta* Plate 2.
- General development — Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

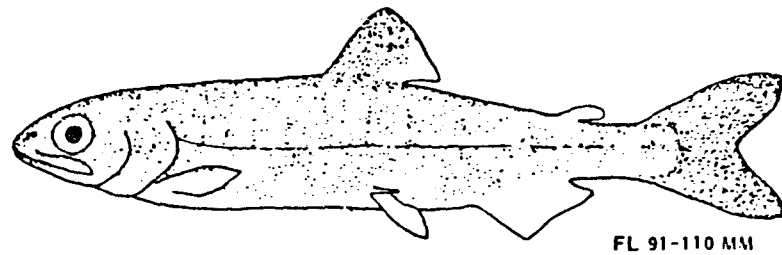
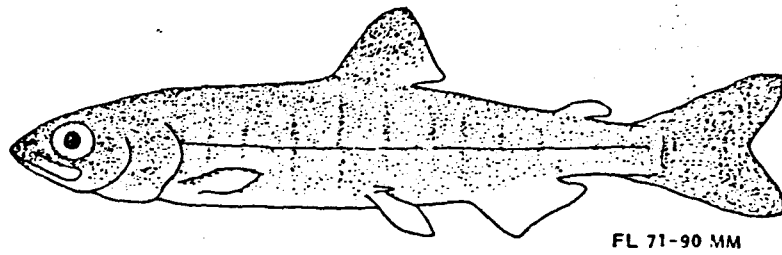
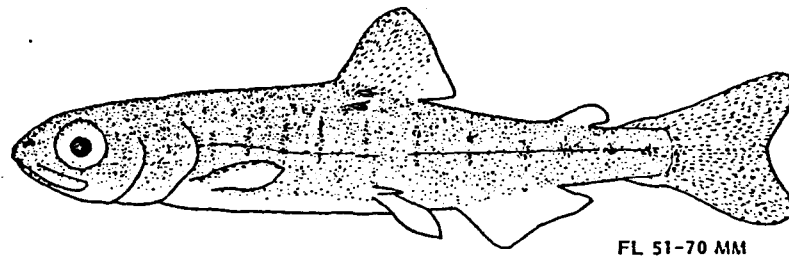
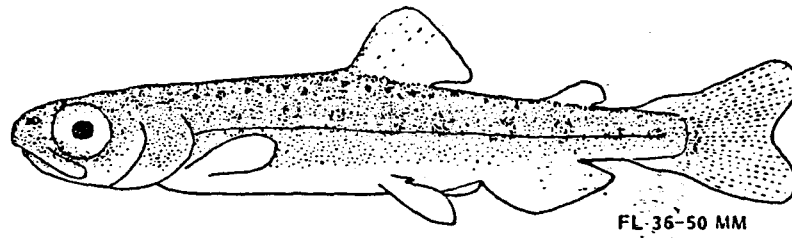
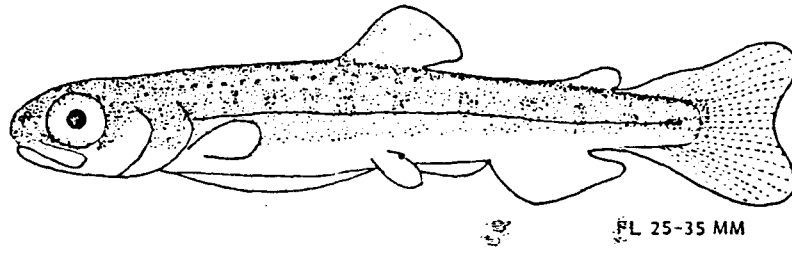


Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrate) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

4b *Combination of*: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally no melanophores on adipose and anal fins. Anterior parr marks more rectangular than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

SOCKEYE (RED) SALMON—*O. nerka*. Plate 3.

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

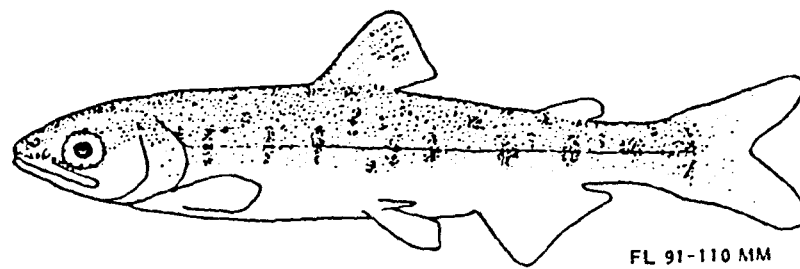
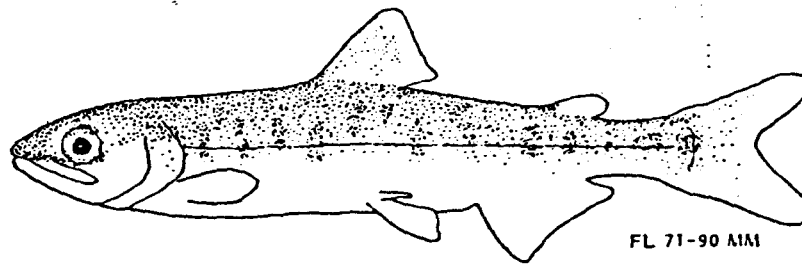
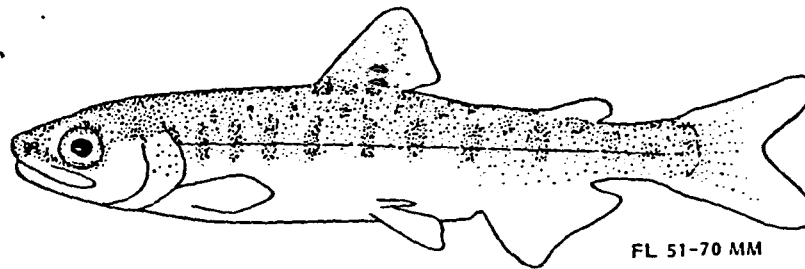
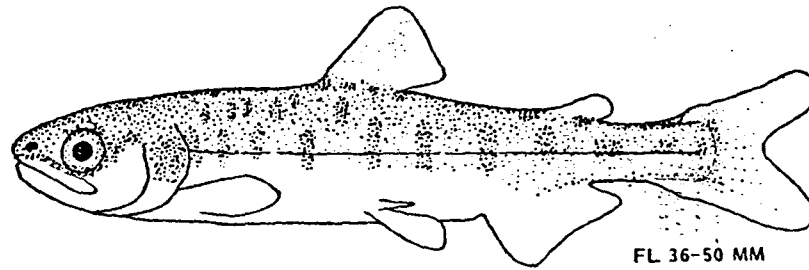
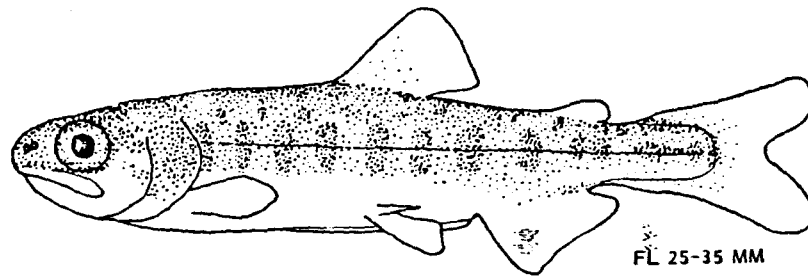


Plate 3.—Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar; in presmolt juveniles over 60 mm FL, spots or bars may disappear, after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

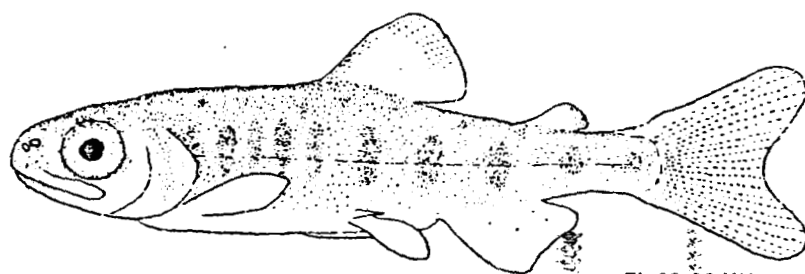
Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

5a

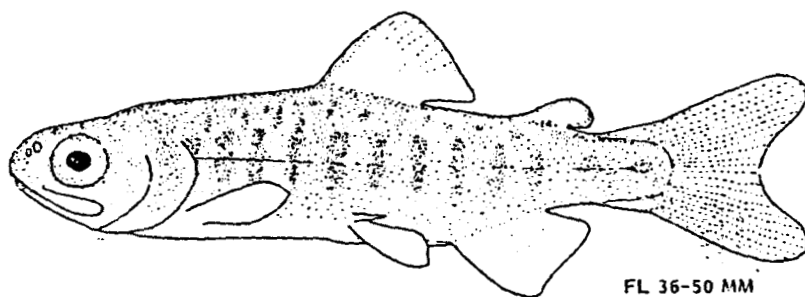
CHINOOK (KING) SALMON—*O. tshawytscha*. Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

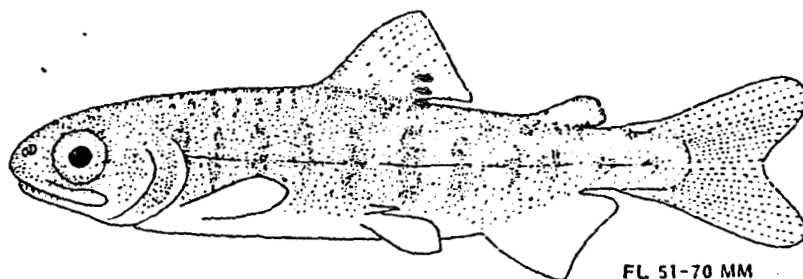
Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.



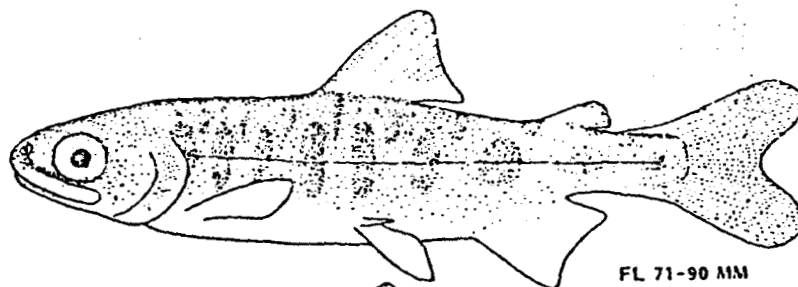
FL 25-35 MM



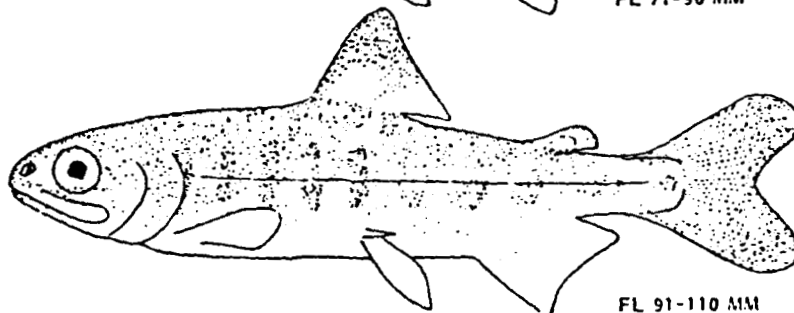
FL 36-50 MM



FL 51-70 MM



FL 71-90 MM



FL 91-110 MM

Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings; blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger presmolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 25 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

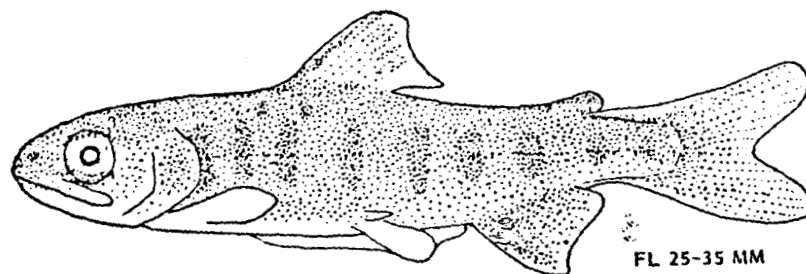
Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

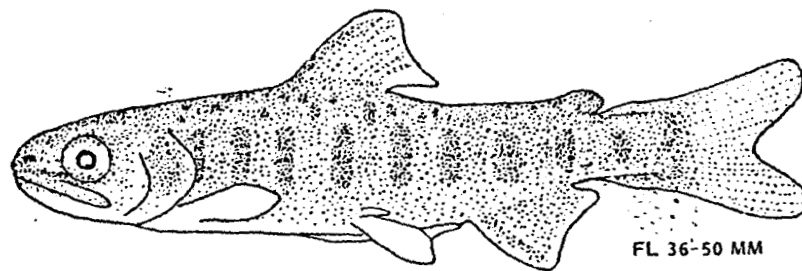
Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*. Plate 5.

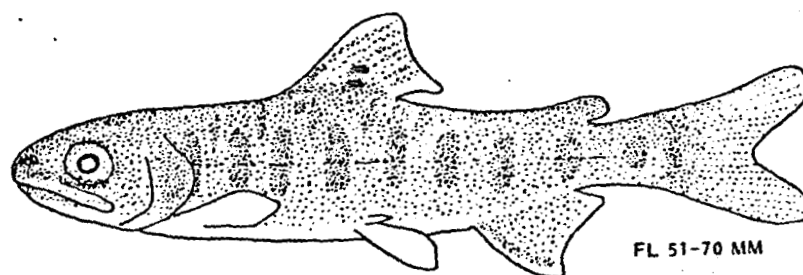
General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-



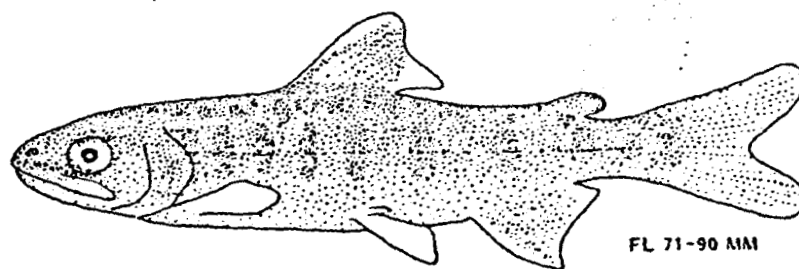
FL 25-35 MM



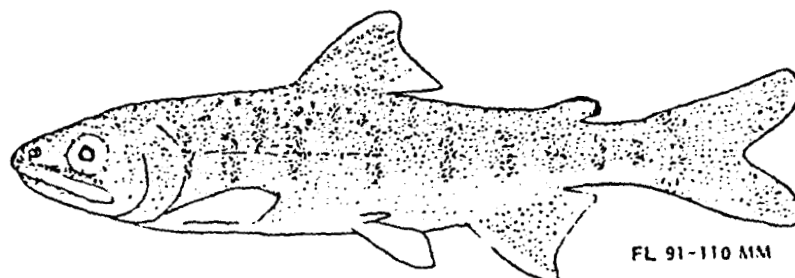
FL 36-50 MM



FL 51-70 MM



FL 71-90 MM



FL 91-110 MM

Plate 5.—Coho salmon.

smolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 0.9 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon; marks usually situated equidistant on each side of lateral line; usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species; dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "Combination of" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

- Adipose fin** A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).
- Anal fin** The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).
- Axillary process or scale** An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).
- Gill opening** Opening between opercle or gill cover and side of head.
- Branchiostegals or branchiostegal rays** Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).
- Caudal fin** Terminal or tail fin of fishes (Fig. 1, No. 12).
- Caudal peduncle** That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).
- Chromatophores** Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.
- Cycloid scales** Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.
- Dorsal fin** In salmons, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).
- Dorsal ridge** Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).
- Dorsal stripe** A band on dorsal ridge which is lighter or darker than adjacent areas.
- Falcate** Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.
- Filaments** See *gill filaments*.
- Fork length** Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmons to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).
- Gill arch** Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).
- Gill cover, opercle, or operculum** Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).
- Gill filaments (lamellae)** Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).
- Gill rakers** Projections on anterior edge of first gill arch (Fig. 2, No. 1).
- Head length** Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).
- Hypural** Complex of expanded and fused bones of last few vertebrae which support caudal fins in certain fishes.
- Jack** Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.
- Juvenile** As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.
- Lamellae** See *gill filaments*.
- Lateral line** A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).
- Lateral line scale count** A count of pored scales from first scale on body behind head posteriorly to above hypural.
- Melanophores** Chromatophores with dark or black pigment.
- Parr marks** Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).
- Pectoral fins** Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).
- Pelvic fins** A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).
- Postdorsal ridge** That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).
- Predorsal ridge** That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).
- Presmolt** A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.
- Pupil of eye** Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).
- Pyloric caeca** Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers*.

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Terete Nearly cylindrical in cross section and tapering toward the front and rear.

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Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish¹ that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alter-

native characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics—and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

KEY

1. (47) Adipose fin and scales present.
(Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

¹ Especially adult smelt, family Osmeridae.

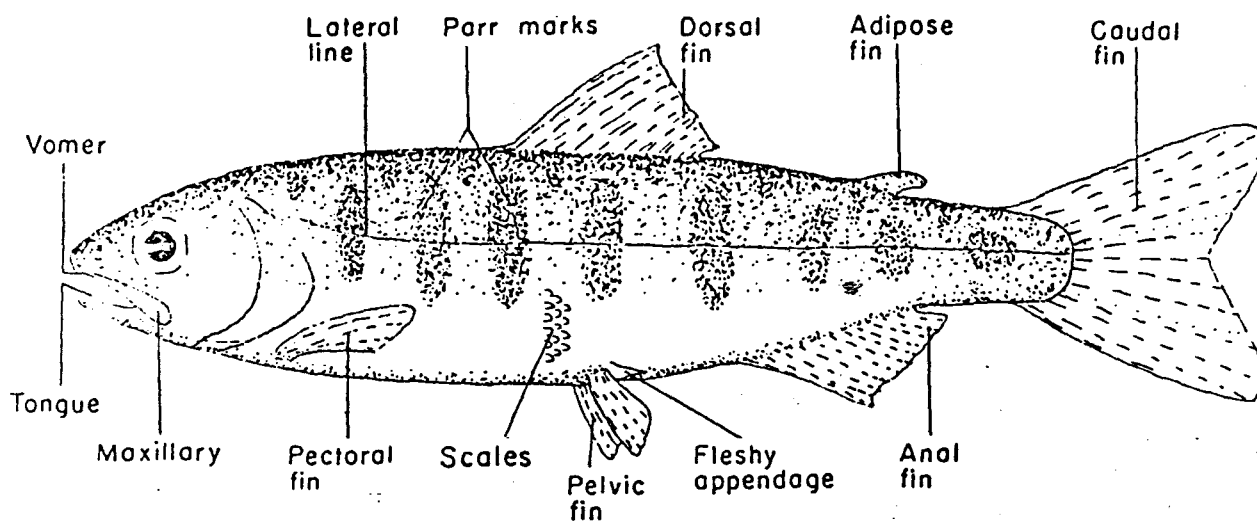


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

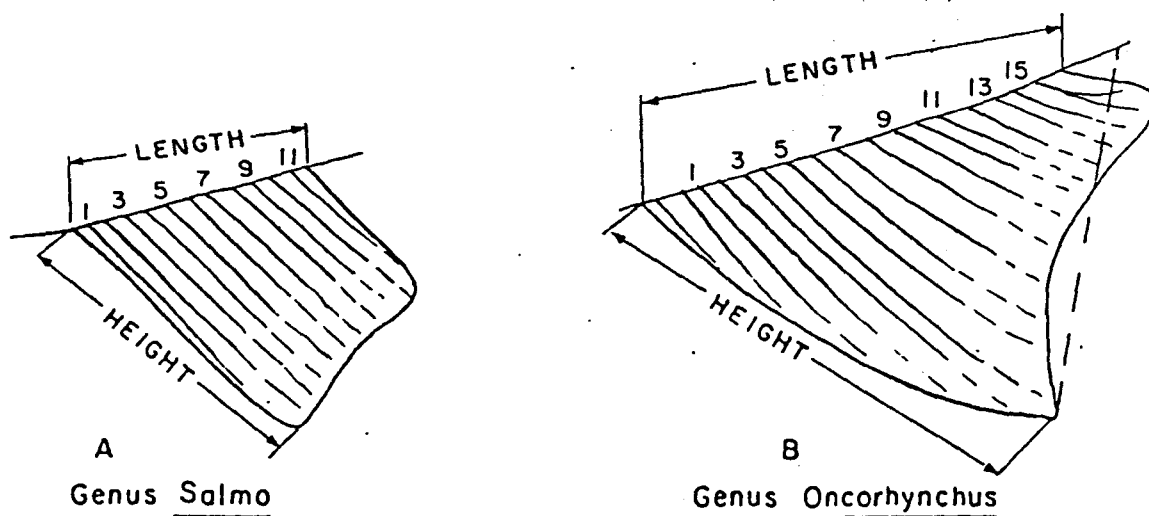


Figure 2.—Anal fins: (A) Trout, genus *Salmo*; (B) Pacific salmon, genus *Oncorhynchus*. The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

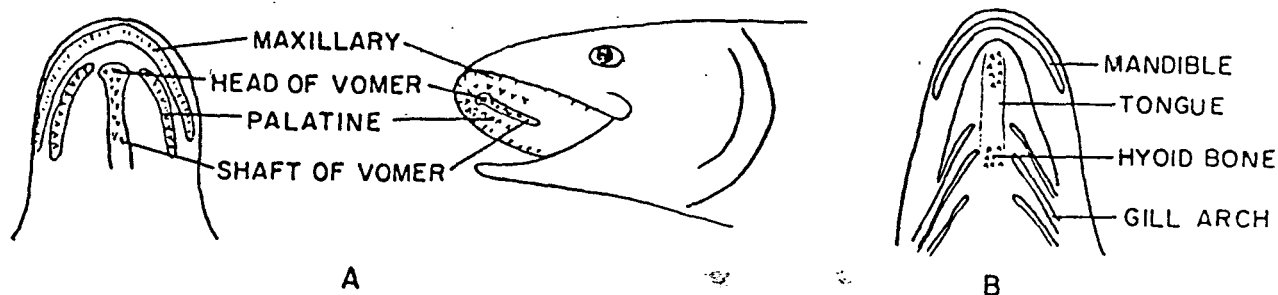
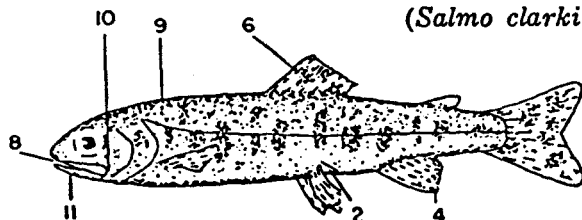


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

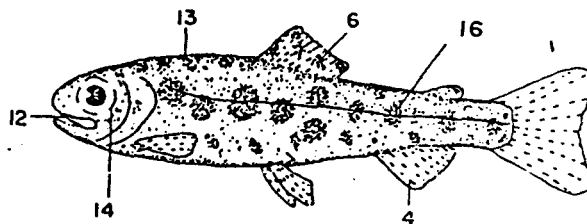
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.

Cutthroat trout
(*Salmo clarki*)



16. (20) Parr marks almost round.
Rainbow or steelhead trout
(*Salmo gairdneri*)

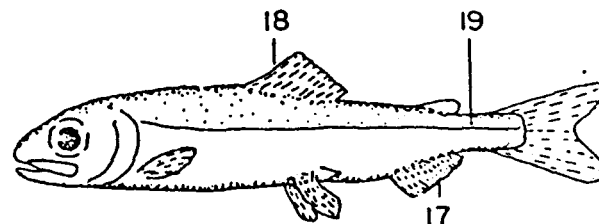


17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.

Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.

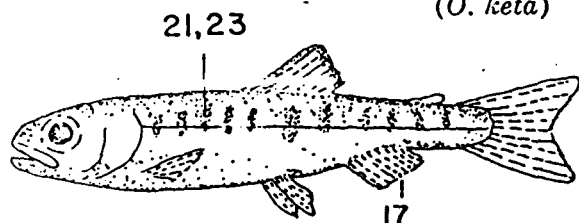
Pink salmon
(*O. gorbuscha*)



12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

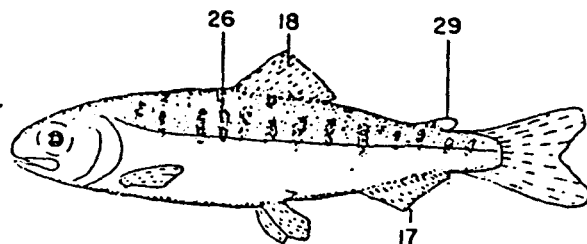
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26.
** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



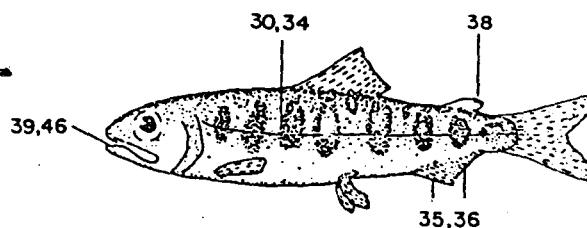
25. (22) Gill rakers on first arch, 30 to 40.
**Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



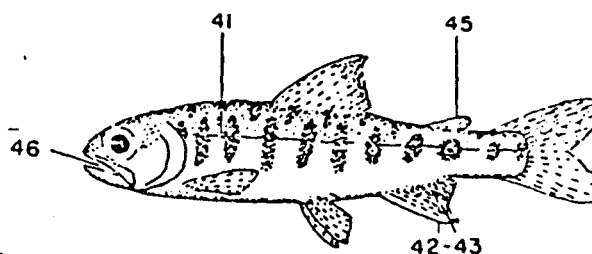
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Pyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Pyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.
Not Salmonidae
48. (2) No fleshy appendage at base of pelvic fins.
Smelts
Family Osmeridae
49. (3) Mouth small, not reaching center of eye; teeth weak or absent.
50. (51) Depressed dorsal fin, shorter than head.
Whitefishes
Genus *Coregonus*
51. (50) Depressed dorsal fin, longer than head.
Arctic grayling
(*Thymallus arcticus*)
52. (5) **Teeth on head of vomer only.
Charrs
Genus *Salvelinus*
Dolly Varden (*S. malma*)
53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.
Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

We especially thank Dr. Arthur D. Welander, Professor of Fisheries, and Dr. Bruce S. Miller, Research Biologist, College of Fisheries, University of Washington, Seattle, for their valuable suggestions. We also thank Galen H. Maxfield, Fishery Biologist, and Dr. Alan J. Beardsley, Fishery Biologist, both from the NMFS Northwest Fisheries Center, Seattle.

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APPENDIX B

Procedures for Sampling Salmon Smolt for age, length, and weight

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix B.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix B.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code; 1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

of Cards: Mark 1 (each AWL form is individually numbered)
Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

Sampling procedure

Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, Appendix B.3. The scales will be mounted on a glass slide as illustrated in Appendix B.4. The left portion of each slide will be labeled: location, date, AWL # (card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix B.4.. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix B.5. Record each length by darkening the appropriate column blocks on the AWL form.

Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix B.1). Each length and weight measurement must represent the corresponding scale smear.

DESCRIPTION: Sockeye smolt

Pope, Bauwens, Glamen

ADF&G ADULT SALMON AGE-LENGTH
FORM VERSION 2.1Litho
Code

DO NOT WRITE IN THIS MARGIN

234825

DO NOT WRITE IN THIS AREA

[illegible]

NCS DOCUSCAN[®] MB20-17877-131211 A4200

SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1					
2					
3					
4					
5					
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98					
99					
100					

Weights	10's	1's	1/10's
---------	------	-----	--------

SPECIES

- 1 - Chinook (king)
2 - Sockeye (red)
3 - Coho (silver)
4 - Pink (humpy)
5 - Chum (dog)

PROJECT

- 1 - Commercial catch
- 2 - Subsystem catch
- 3 - Escapement (tower, crew, tower into pit)
- 4 - Escapement - spawning grounds
- 5 - Test fishing
- 6 - Spot catch (spring)
- 7 - Spot catch (freshwater)

GEAR TYPE

- | | |
|-------------------|--------------------|
| 0 - Trip | 11 - Heavy seas |
| 1 - Fair sea | seas |
| 2 - Beach sweep | 12 - Sandpunched |
| 3 - Break gulfnet | 13 - Ship net |
| 4 - Set gulfnet | 14 - 15 Unassisted |
| 5 - Trawl | 16 - Beach haul |
| 6 - Long haul | 17 - Shovel |
| 7 - Otter trawl | 18 - Wear |
| 8 - Fishhead | 19 - 25 Unassisted |
| 9 - Pile | |
| 10 - Sport boat | |
| | and two |

LENGTH TYPE

- 1 - Tip of snout to back of head
- 2 - Mid eye to back of head
- 3 - Post orbit to back of head
- 4 - Mid eye to hypural plate
- 5 - Post orbit to hypural plate
- 6 - Unmeasured

AGE ERROR CODES

- 1 - Death
- 2 - Injured
- 3 - Regenerated
- 4 - Missing
- 5 - Missing
- 6 - Rescued
- 7 - Wrong species
- 8 - Not prepared

Litho —
Code
Transferred

DO NOT MARK IN THIS MARGIN

**TRANSFER RESPONSES
EXACTLY AS PRINTED
ON FRONT TO THIS CARD**

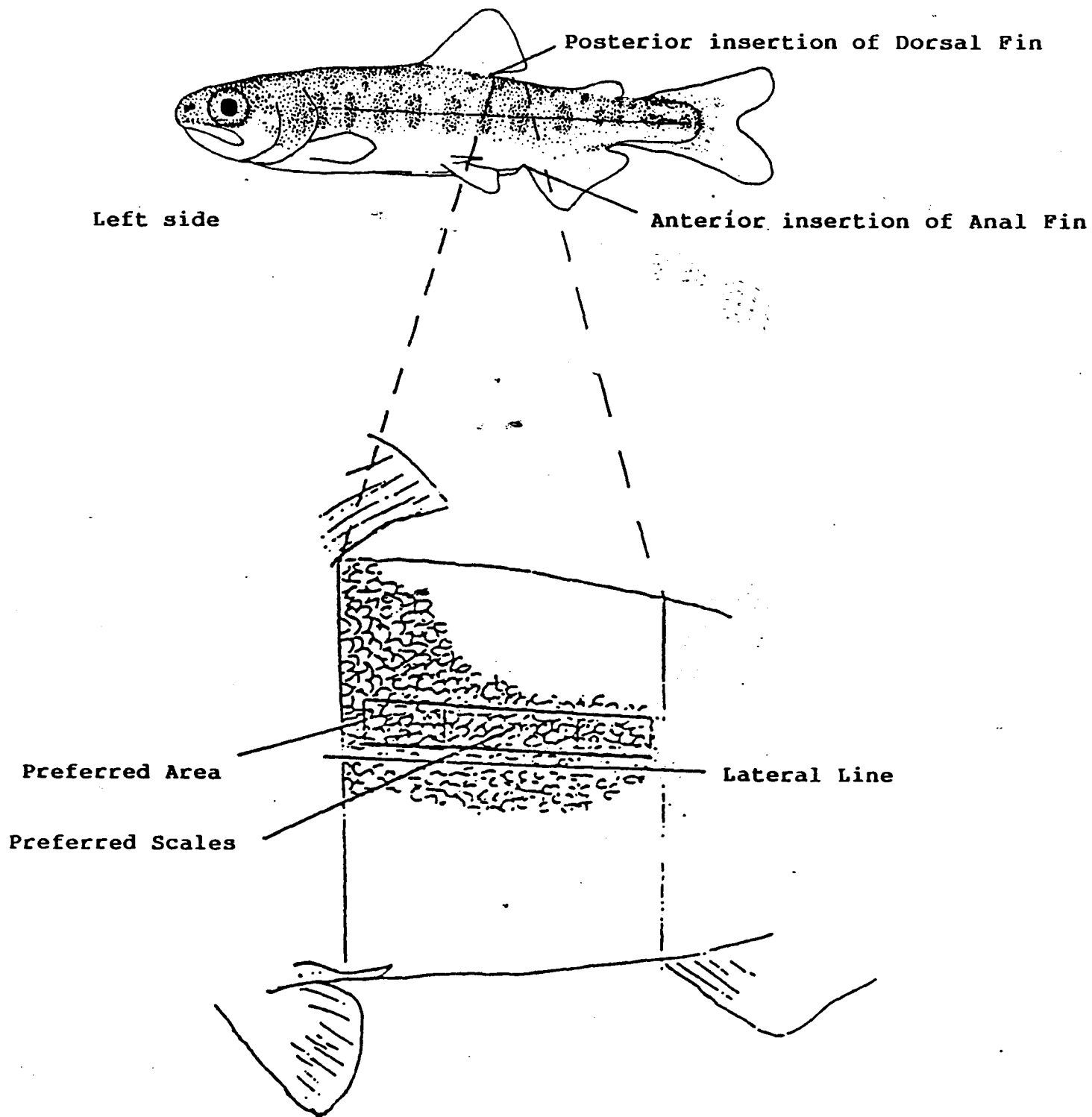
DO NOT WRITE IN THIS AREA

[illegible]

Appendix B.2. Period codes and corresponding dates.

Period	Dates		Period	Dates	
1	01-Jan	to 03-Jan	28	05-July	to 11-July
2	04-Jan	to 10-Jan	29	12-July	to 18-July
3	11-Jan	to 17-Jan	30	19-July	to 25-July
4	18-Jan	to 24-Jan	31	26-July	to 01-Aug
5	25-Jan	to 31-Jan	32	02-Aug	to 08-Aug
6	01-Feb	to 07-Feb	33	09-Aug	to 15-Aug
7	08-Feb	to 14-Feb	34	16-Aug	to 22-Aug
8	15-Feb	to 21-Feb	35	23-Aug	to 29-Aug
9	22-Feb	to 28-Feb	36	30-Aug	to 05-Sep
10	01-Mar	to 07-Mar	37	06-Sep	to 12-Sep
11	08-Mar	to 14-Mar	38	13-Sep	to 19-Sep
12	15-Mar	to 21-Mar	39	20-Sep	to 26-Sep
13	22-Mar	to 28-Mar	40	27-Sep	to 03-Oct
14	29-Mar	to 04-Apr	41	04-Oct	to 10-Oct
15	05-Apr	to 11-Apr	42	11-Oct	to 17-Oct
16	12-Apr	to 18-Apr	43	18-Oct	to 24-Oct
17	19-Apr	to 25-Apr	44	25-Oct	to 31-Oct
18	26-Apr	to 02-May	45	01-Nov	to 07-Nov
19	03-May	to 09-May	46	08-Nov	to 14-Nov
20	10-May	to 16-May	47	15-Nov	to 21-Nov
21	17-May	to 23-May	48	22-Nov	to 28-Nov
22	24-May	to 30-May	49	29-Nov	to 05-Dec
23	31-May	to 06-June	50	06-Dec	to 12-Dec
24	07-June	to 13-June	51	13-Dec	to 19-Dec
25	14-June	to 20-June	52	20-Dec	to 26-Dec
26	21-June	to 27-June	53	27-Dec	to 31-Dec
27	28-June	to 04-July			

Appendix B.3. Scale sampling procedure showing the preferred area on a smolt salmon.



Appendix B.4.

SALMON SMOLT GLASS SLIDE EXAMPLE

The following information should be legibly written on the slide label:

1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10, etc.)

AWL #009 RED LAKE 5/16/93 FISH 1-5	#1					#5
---	----	--	--	--	--	----

AWL #009 RED LAKE 5/16/93 FISH 6-10	#6					#10
--	----	--	--	--	--	-----

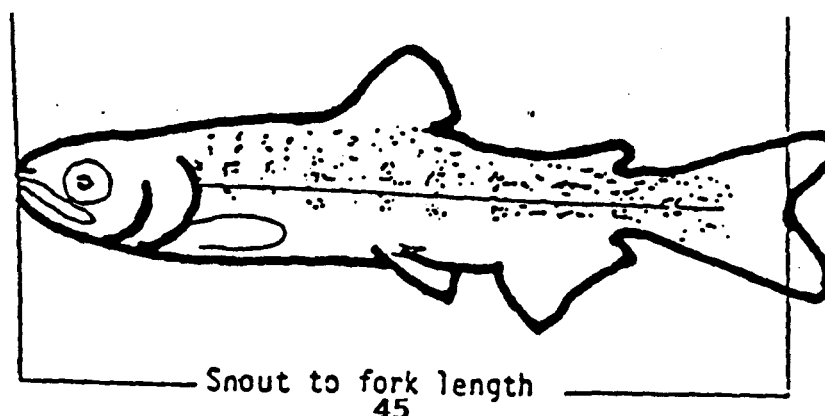
When the slides are completed, return them to the box in order by AWL # and fish#, and label the slide box on top with the following information:

Location (RED LAKE)
AWL Numbers (AWL # 009 - 018)
Beginning and ending dates (5/16 - 20/93)

cat. no. 48300-025	
VWR VWR VWR	micro slides
RED LAKE Smolt.	
AWL : 009 - 018	
5/16 - 20/93	
VWR VWR	25 x 75 mm
VWR Scientific Inc. Media, PA. 19063	VWR Scientific A VWR COMPANY

Appendix B.5

MEASURING SMOLT LENGTH



FRAZER LAKE
1993 OPERATIONAL PLAN



Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, AK 99615

MAY 1993

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INTRODUCTION

Frazer Lake is located on the Southern end of Kodiak Island and is the second largest lake within the Kodiak Archipelago (Figure 1). Frazer is 14.2 km long, 1.6 km wide, with a surface area of 16.1 km². Prior to 1951 Frazer Lake was void of sockeye salmon (*Oncorhynchus nerka*) owing to a 10 meter barrier falls prohibiting anadromous fish from entering the lake (Russell 1972). Egg, fry and adult transplants (1951-1971) from sockeye systems on Kodiak Island (Karluk and Red Lakes) and the Alaska Peninsula (Becharof Lake) established a sockeye salmon run with adults returning for the first time in 1956 (Russell 1972). From 1956-1961 returning adults were back-packed over the falls, and in 1962 a fishpass was constructed to promote access to the lake environment. A second fishpass was installed in 1979 allowing for increased passage capacity during peak migration periods.

Since 1956, enumeration of adults and AWL sampling has been conducted at the Frazer fishpass. Spawning ground surveys have been performed since 1964. Annually, smolt migration timing and magnitude, zooplankton density and community composition, along with limnological characteristics are measured.

Conservative fishery management practices have been very successful at building this run (1970-1985) from 25,000 in 1971 to 645,739 fish in 1985. Blackett (1975) established an escapement goal of 383,000 adults based upon limnological and spawning habitat calculations. Subsequent declines in smolt condition factor, and shifts in zooplankton size and community composition published by Kyle et al. (1986) prompted lowering of the escapement goal to 140,000-200,000 adults. The Frazer Lake sockeye stock is now considered of major importance to the Island wide salmon fishery. Also, this introduced run provides for an enhanced food resource for the local Kodiak brown bear population, stimulating increases in bear densities along Frazer Lake and Dog Salmon Creek streams.

In 1986, ADF&G Fisheries Rehabilitation and Enhancement (FRED) Division transferred operation of the Frazer fishpass facility to the Commercial Fisheries Division which now operates the program. FRED Division since 1988 has applied fertilizer (mixture of Nitrogen and Phosphorous) to the lake hoping to stimulate survival of lake rearing sockeye fry. This program was instituted in response to the dramatic declines in smolt size and weight resulting from excessive escapements which occurred during 1980-1982 and 1985 and was terminated after the 1992 field season.

During 1983, a second weir was installed on Dog Salmon Creek 0.7 km upstream from lower Olga Bay to provide more timely sockeye and pink salmon (*Oncorhynchus gorbuscha*) escapement counts relevant to managing the commercial fishery. Weir personnel also enumerate chinook (*O. tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), steelhead and rainbow trout (*O. mykiss*), and Dolly Varden char (*Salvelinus malma*).

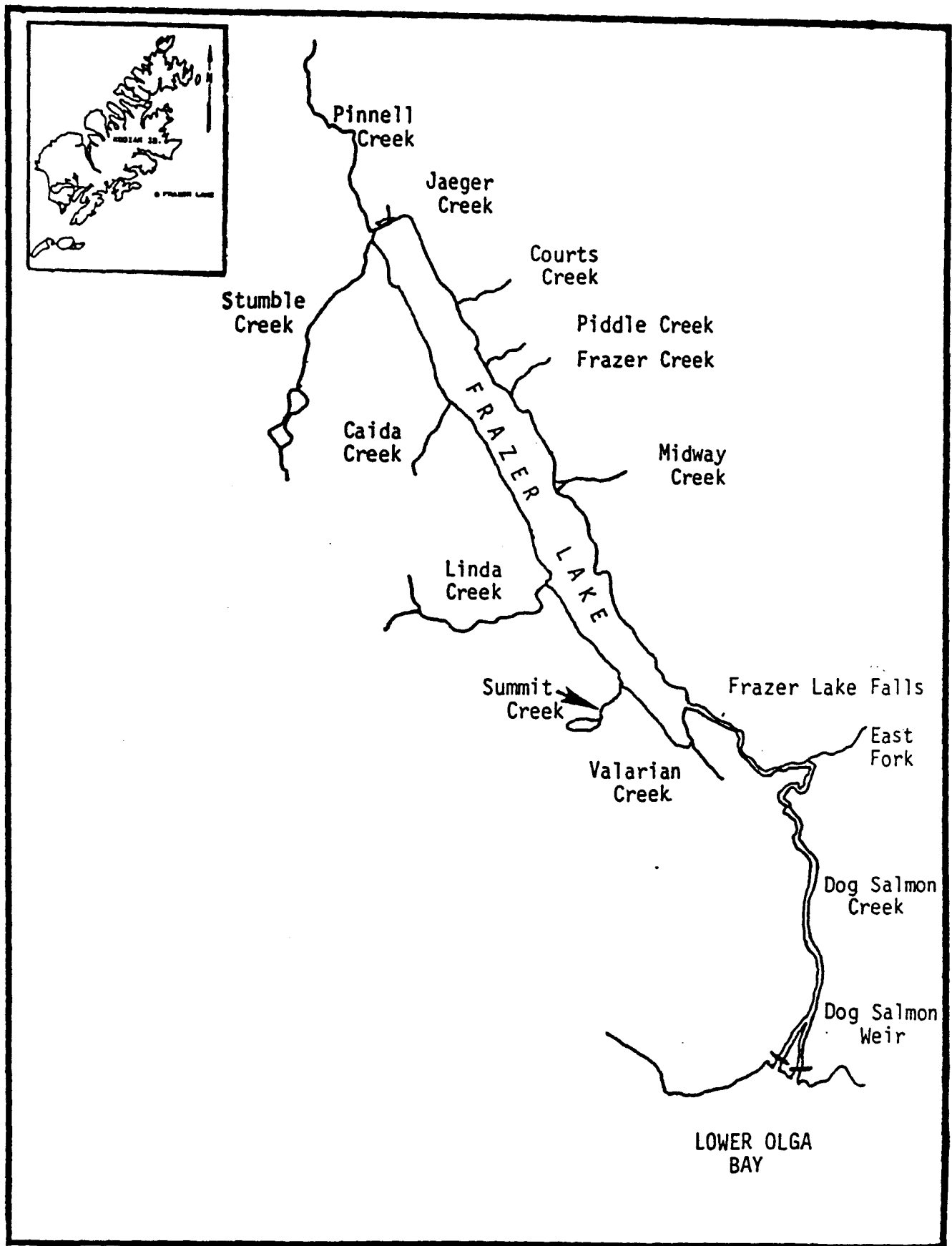


Figure 1. Map depicting Frazer Lake inlet streams.

OBJECTIVES

The Commercial Fisheries Division's goal for the Frazer Lake project is optimizing natural sockeye production, and collection of data relevant to generating accurate preseason run forecasts and escapement goal evaluation. For 1993 specific tasks are:

1. Determine sockeye smolt abundance, timing, age composition, and length and weight at age.
2. Provide unobstructed and timely adult fish passage into the lake environment.
3. Determine escapement timing, magnitude, and spawner distribution.
4. Collect age, sex, and length data from the sockeye escapement.

SUPERVISION

The project leader is Charlie Swanton with Don Pitcher and Mark Larrison being crew leader and assistant, respectively. Don is responsible for scheduling daily work assignments, assuring collected data adheres to plan standards, and that safety is priority. A brief chronology of assignments is presented (Table 1). Mr. Pitcher is also responsible for making sure that both himself and Mr. Larrison have read and understand the Department's **field safety policy** and have signed the **EMPLOYEE SAFETY SOP VERIFICATION** and made sure that these documents are secured by the project leader prior to departing for the field. In addition, a written season summary report will be required from the crew leader.

PROCEDURES

Smolt Sampling and Population Estimation

The smolt program has two components, abundance estimation and AWL sampling. Abundance will be derived using catches from two traps (concrete and inclined plane) operated from about 10 May to about 15 July. Each trap will be checked about every 30 minutes each night and catch enumerated by species, recorded (Figure 2), and released. Trap catch efficiency will be generated from mark-recapture experiments using Bismark brown-Y dye. The sample size for marked fish is 1000 smolt collected (optimally in a single night) over a maximum of two days. Smolt selected for dying from both traps should be proportional to catches from each trap. A maximum of three days is the time span for obtaining smolt used for a particular mark recapture event. Smolt transport will be from the holding tank (covered to reduce stress) adjacent to the traps to the dyed smolt release site located about 0.5 km above the diversion weir. Transport will be in 30 gallon plastic tubs attached to the trailer and aerated continuously. After transport, smolt will be placed in the instream holding tank and monitored for 30 minutes prior to initiating the dye process. The amount of dye will be 1.3 g per 10 gallons of water (30 gal of solution should be adequate for 1,000 fish); smolt should be emersed in the dye solution tank (with cover) for 30 minutes. All dyed smolt prior to release are to be held for approximately 60 minutes within the instream holding tank and closely scrutinized for abnormal behavior; any smolt which

Table 1. Season summary of events.

Date	Event	Frequency
5/7	Open camp, install lower diversion weir and smolt traps.	
5/10-8/24	Camp and equipment maintenance as needed	
5/10-6/15	Fishpass maintenance as needed	
5/8-7/15	Sockeye smolt	enumeration every 30 minutes daily; sample 70/day 5 days/week; mark-recapture 1,000/week (if available).
~6/15-8/25	Adult sockeye	enumeration daily ALS sample 240 once a week.
7/15-8/25	Foot surveys	Linda and Midway Creeks (once a week).
~8/25	Close camp	

DAILY SMOLT CATCH REPORTING FORM

TRAP NUMBER _____

PROJECT LOCATION

DATE _____

TIME (MILITARY)	SOCKEYE SMOLT (numbers)			OTHER (numbers)			COMMENTS 2/
	CATCH 1/ DATE	EXAMINED FOR MARKS	MARKED RECOVERIES	COHO	DOLLY V.	STICKLEB.	
TOTAL							

1/ Catch number does not include marked recoveries.

2/ To be included in comments: estimate young-of-year fry numbers by species and number of sockeye smolt mortalities.

show signs of stress will NOT be released. Dyed smolt are to be released evenly spaced across the stream at a site providing suitable cover. Timing of the process should be late afternoon (3-4 pm). The dyed fish total recorded should reflect only those fish which were actually released (Figure 3). All catch data of marked and unmarked fish will be recorded separately for each trap (Figure 4). Monitoring marked-unmarked fish recovery will commence the evening of dyed smolt release and continue for the next two consecutive smolt days. During the initial stages of smolt outmigration monitoring, smolt numbers may be such that the 1000 fish sample size is not attainable. In these instances, a minimum of 150 smolt from both traps combined in a single night will be the benchmark for instituting a dye test, and again the following night. This will provide for a minimum sample size of 300 smolt captured over a two day period. If this situation exists, all smolt will be subjected to the dye process and released in a single night. Smolt age, weight, and length sampling will be proportional to catch from each trap with 70 smolt per day sampled for five consecutive days. Typically no samples will be collected on wednesday and sunday with a dye test conducted on one of these days. If total catch for both traps are less than 70 fish, all smolt will be sampled. **Data will be recorded on standard AWL forms consecutively numbered corresponding to slides (Appendix A).** In order for the optical scanning machine to collect all data recorded the litho code (left hand side on the front of AWL form) needs to be transcribed to the back of the form. AWL litho codes should be consecutively ordered by number which allows for database manipulation. Microscope slides will have scales from five fish aligned in rows and separated so that ageing is possible. **Blank slides and AWL forms will be used for each day of sampling.**

Escapement Passage

The old fishpass will be operated from approximately 15 June-21 August, with the starting date scheduled to minimize smolt passage through the fishpass. Commencement of fishpass operations will occur the day after sockeye are first counted through Dog Salmon weir. New fishpass operation will proceed only after consultation with the project leader and/or Bruce Barrett. This structure has not been used for fish passage since about 1986. Diversion weirs above and below the Frazer falls will be inspected daily for holes, and cleaned when required. Specific instructions for fishpass maintenance and operation are provided (Appendix B). If time allows hardware cloth or other residual netting located on site will be attached to the top of the weir pickets of the lower diversion weir to prevent sockeye from jumping over the weir and staging below the falls. This has occurred in the past and can result in the crew having to seine fish between the weir and falls. Diligence in daily inspection of both the above and below falls diversion weirs may also allow for determining where the fish between the falls and lower diversion weir are originating from. At fishpass entrance bulkhead astroturf padding installed on the bulkhead will minimize fish mortality.

Escapement counting frequency will be scheduled to minimize migration delay. Specifically, counts will be made at least four times daily, and during peak escapement with increased frequency. Individual counts by species will be recorded using hand-held tally counters and data recorded (Figure 5). A standard escapement counting and sampling week will extend from sunday to sunday (statistical week; Appendix C).

Figure 3.

SMOLT DYE RELEASE FORM

DATE (actual): _____

CREW NAMES (print) _____

PROJECT LOCATION _____

NUMBER OF FISH COLLECTED: _____
(from live box)

CREW LEADER
(signature) _____

	COLLECTION LIVE BOX	TRANSPORT BUCKET	RECOVERY CONTAINER	DYE TUB	RECOVERY CONTAINER	TRANSPORT BUCKET	STREAM RELEASE
START TIME (military)							
START TEMP (degree celsius)							
END MORTALITY (number of fish)							
OXYGEN SUPPLEMENT O2 or aerator (A)							

DYE SOLUTION (mixture): _____ Dye (grams); _____ Water (gallons)

RELEASE SITE LOCATION (distance upstream of trap site, in miles) _____

TOTAL NUMBER OF DYED FISH RELEASED: _____

COMMENTS:

SCKEYE SALMON SMOLT SUMMARY FORM

PROJECT LOCATION: _____

[illegible]

2/ Numbers of fish caught does not include marked recoveries.

Figure 5.

ALASKA DEPARTMENT OF FISH AND GAME
KODIAK MANAGEMENT AREA
WEEKLY SALMON WEIR CAMP REPORT FOR YEAR: _____

NAME: _____ WEIR CAMP PERSONNEL: _____ NO. _____ WEEKLY REPORT FOR WEEK ENDING (SATURDAY) _____

DATE	DAILY TOTAL SALMON ESCAPEMENT						DAILY TOTALS	JACK NO.	REDS %	STEELHEAD		DOLLYS UP	GILLNET MARKED		H ₂ O LEVEL		H ₂ O TEMP	WEATHER		
	REDS	L. REDS	KINGS	PINKS	COHOS	CHUMS				DOWN	UP		REDS	OTHERS	UP	DOWN		CEIL.	VIS.	WIND DIR/SPD.
SUN D																				
SUN A																				
MON D																				
MON A																				
TUE D																				
TUE A																				
WED D																				
WED A																				
THU D																				
THU A																				
FRI D																				
FRI A																				
SAT D																				
SAT A																				
TOTAL FOR WK																		COMMENTS:		
ACCUM THRU WK																		COMMENTS:		
WEIR MORTS FOR WK TOT ACCUM																		COMMENTS:		
AWL SAMP FOR WK TOT ACCUM																		COMMENTS:		

ADDITIONAL COMMENTS: BEAR AND PEOPLE PROBLEMS; SMOLT MIGRATION; WEIR PROBLEMS; CABIN REPAIR; NOTE AIRCRAFT TRAFFIC

Escapement Sampling

Sockeye escapement age, length, and sex (ALS) sampling will be conducted weekly (statistical week) over a one to two day period. Sample size per week is 240 fish (Table 1). If possible collect the sample during a single day, but do not extend beyond two consecutive days even if fewer than a 240 sample has been collected. Procedures for collecting and recording ALS data are given (Appendix C).

Stream and Lake Escapement Surveys

The primary objective of lake and stream surveys are to document distribution and abundance of sockeye within stream and lake shoal areas. Surveys will be conducted weekly from 15 July-21 August on Linda and Midway Creeks, only. Streams will be surveyed to the upper limits of spawner distribution and live and dead fish recorded (Figure 6). Additionally, spawner limits will be noted on U.S geological survey topographic maps for each stream. Stream mouth counts will be recorded separate from actual stream counts. Observers will survey on foot and enumerate live and dead sockeye using polarized glasses, and tally counters. Before conducting surveys, tally counters will be inspected for proper functioning. An additional survey task will be to conduct surveys of the lake outlet stream between the lake and barrier falls several times prior to seasons end. Some concern has been generated that sockeye salmon may use this area for spawning.

Season Summary Report

The summary report should be a brief synopsis of the field season and include: (1) a chronology of sampling events and data collection (i.e. smolt and adult counting and sampling operations commenced and ceased ect.); (2) problems incurred during the season including sampling and field camp operations; (3) suggestions for improvements/modifications to the enumeration and sampling programs; (4) equipment/building supplies for following field season. In addition, the crew leader is responsible for writing a performance evaluation for the field crew. The evaluation should be discussed with the technician prior to forwarding it to the project leader.

The data collected from this project will be published within a technical fishery report which will summarize data collected since 1988.

MAINTENANCE AND BUILDING PROJECTS

Several building projects will be completed on a time available basis during the 1993 field season they are: (1) Resting tank entrance and exit chute repair and attachment of plywood collars; (2) resting pool tank cover replacement; (3) stabilizing the I-beams which support the upper diversion weir; (4) completion of the sauna/bathhouse located adjacent to the main facilities; adequate lumber should exist on site for this project; and (5) measuring the planks for the weir catwalk.

SOCKEYE SALMON STREAM SURVEY LOG

[illegible]

APPENDIX A

Procedures for Sampling Salmon Smolt for Age, Length, and Weight

The sample size is 70 sockeye salmon smolt per day, five days a week. If daily sampling objectives are being met, sampling will not occur on Wednesday and Sunday. It is essential that the sample be taken randomly. In the event that more than the required sample size is in the smolt trap at the time of sampling, the trap is to be stirred to assure randomness. When the smolt are randomly distributed, a small dip net will be used to remove a subsample. This procedure will be repeated until the sample goal is met.

AWL Forms

Smolt length and weight will be recorded on AWL forms (Appendix A.1). Using a No. 2 pencil, complete each section of the left side of the AWL and darken the corresponding blocks:

Description: Include species (sockeye smolt), location, year, and samplers.

Card: The AWL forms and corresponding slides are numbered sequentially by date throughout the season starting with # 001. A new, consecutively numbered, card is used each day even if the previous card is not completed. There may be a minimum of one fish and a maximum of 40 fish (8 slides) per AWL.

Species: Refer to the reverse side of the AWL form to obtain species; sockeye = 2.

Day, Month, Year: Use the appropriate digits for the date the fish are sampled.

District, Subdistrict, Stream, Location: Consult project leader for the appropriate codes.

Period: List the period in which the fish were sampled using Appendix A.2.

Project: Refer to the reverse side of the AWL form to obtain code; code 4 will be used as default since a specific smolt code does not exist.

Gear: Refer to the reverse side of the AWL form to obtain code; 00 = trap.

Mesh: Leave blank.

Type of Length Measurement: Refer to the reverse side of the AWL form to obtain code;
1 = Tip-of-snout to fork-of-tail.

Number of Scales: Mark 1 (refers to 1 smear/fish)

of Cards: Mark 1 (each AWL form is individually numbered)
Keep the litho codes in numerical order throughout the season and be sure to transfer the litho code from the front left side to the backside of the AWL form. These forms will be optically scanned and stray marks may be misinterpreted. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

Sampling procedure

Smolt will be kept alive and sampled the day of capture. MS222 will be used to anesthetize the fish. The use of this chemical will be demonstrated in the field. A flattened probe will be used to remove 5-10 scales from the preferred area, Appendix A.3. The scales will be mounted on a glass slide as illustrated in Appendix A.4. The left portion of each slide will be labeled: location, date, AWL # (card #), and fish numbers (1-5, 6-10, 11-15, etc.). When the slides are completed, return them to the box in order, and label the box as shown in Appendix A.4.. Smolt lengths will be measured in millimeters from the tip of the snout to the fork of the tail, Appendix A.5. Record each length by darkening the appropriate column blocks on the AWL form.

Excess water will be removed from the smolt before weighing by using a paper towel blotter. Individual smolt weights will be recorded to the nearest 0.1 gram on the backside (right side) of the AWL form (Appendix A.1). Each length and weight measurement must represent the corresponding scale smear.

DESCRIPTION: **RED LAKE 1492**
SOCKEYE SMOLT

Popo, Bauwens, Glamen

ADF&G ADULT SALMON AGE-LENGTH
 FORM VERSION 2.1

CARD: 033

SPECIES: 2

DAY: 04

MONTH: 06

YEAR: 92

DISTRICT: 256

SUBDISTRICT: 20

STREAM: 201

LOCATION: RED LAKE

PERIOD: 23

PROJECT: 4

GEAR: 0

MESH:

TYPE OF LENGTH MEASUREMENT: 1

NUMBER SCALES/FISH: 1

OF CARDS: 1

NCS DOCUSCAN M820-17877-131211 A4200

SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1					
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98					
99					
100					

Litho
Code

DO NOT WRITE IN THIS MARGIN

234825

Weights 10's 1's 1/10's

SPECIES

- 1 - Chinook (ling)
- 2 - Sockeye (red)
- 3 - Coho (silver)
- 4 - Pink (humpy)
- 5 - Chum (dog)

PROJECT

- 1 - Commercial catch
- 2 - Subsistence catch
- 3 - Recreational (tourist, mail, boat, etc.)
- 4 - Recreational - spawning grounds
- 5 - Test fishing
- 6 - Sport catch (juniors)
- 7 - Sport catch (professionals)

GEAR TYPE

- 0 - Trap
- 1 - Purse seine
- 2 - Beach seine
- 3 - Gill net
- 4 - Set gillnet
- 5 - Trawl
- 6 - Long line
- 7 - Otter trawl
- 8 - Fishhook
- 9 - Pole
- 10 - Sport hook and line
- 11 - Harrow seine
- 12 - Handnet
- 13 - Dip net
- 14 - 15 Unassigned
- 16 - Beam trawl
- 17 - Skimmer
- 18 - Weir
- 19 - 20 Unassigned

LENGTH TYPE

- 1 - Tip of snout to fork of tail
- 2 - Mid eye to fork of tail
- 3 - Post orbit to fork of tail
- 4 - Mid eye to opercular plate
- 5 - Post orbit to opercular plate
- 6 - Unassigned

AGE ERROR CODES

- 1 - Branch
- 2 - Unread
- 3 - Regenerated
- 4 - Missing
- 5 - Missing
- 6 - Rechecked
- 7 - Wrong species
- 8 - Not preferred

Litho
Code

Transferred

DO NOT MARK IN THIS MARGIN

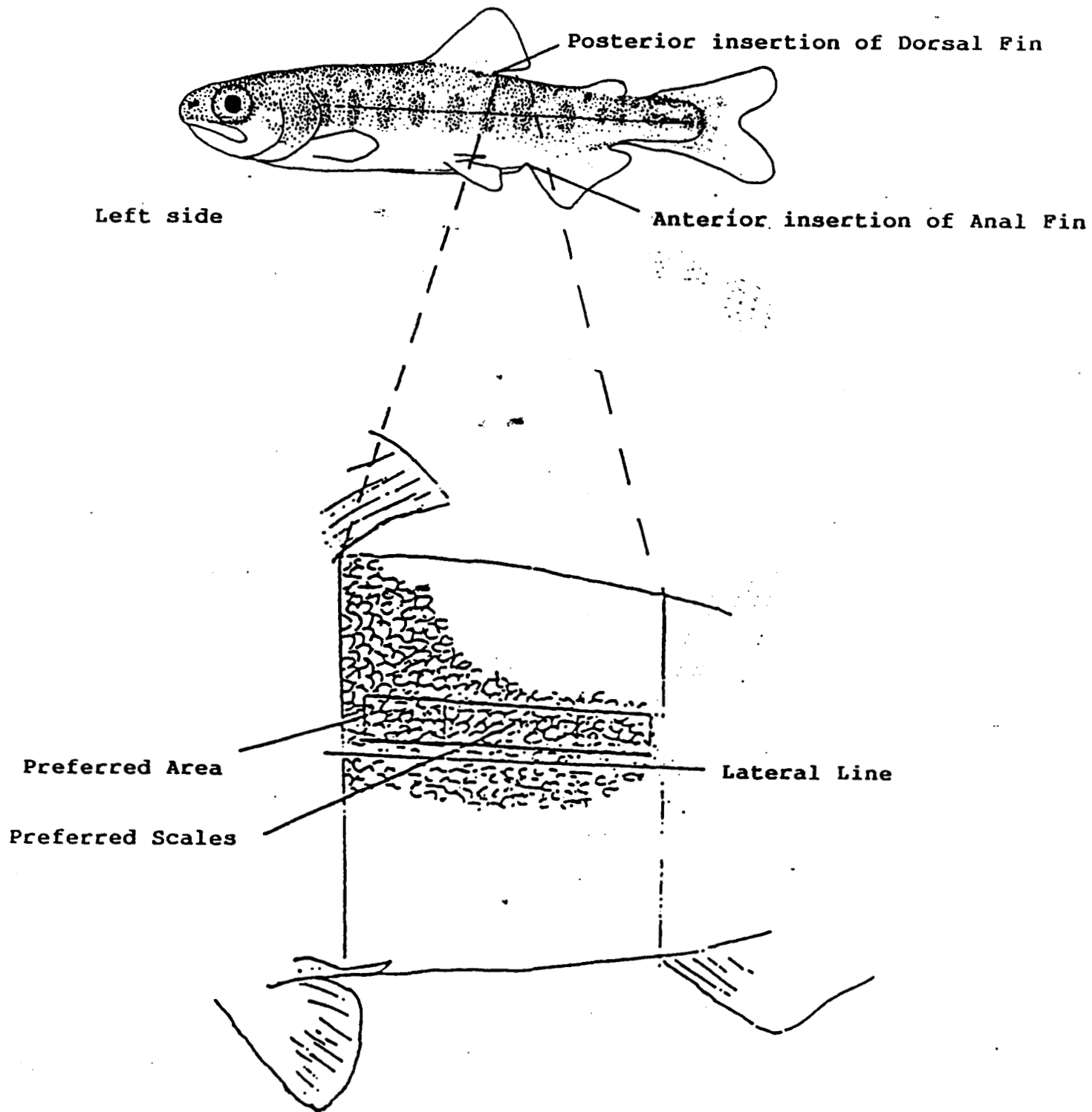
TRANSFER RESPONSES
 EXACTLY AS PRINTED
 ON FRONT TO THIS GRID

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Appendix A.2. Period codes and corresponding dates.

Period	Dates		Period	Dates	
1	01-Jan	to 03-Jan	28	05-July	to 11-July
2	04-Jan	to 10-Jan	29	12-July	to 18-July
3	11-Jan	to 17-Jan	30	19-July	to 25-July
4	18-Jan	to 24-Jan	31	26-July	to 01-Aug
5	25-Jan	to 31-Jan	32	02-Aug	to 08-Aug
6	01-Feb	to 07-Feb	33	09-Aug	to 15-Aug
7	08-Feb	to 14-Feb	34	16-Aug	to 22-Aug
8	15-Feb	to 21-Feb	35	23-Aug	to 29-Aug
9	22-Feb	to 28-Feb	36	30-Aug	to 05-Sep
10	01-Mar	to 07-Mar	37	06-Sep	to 12-Sep
11	08-Mar	to 14-Mar	38	13-Sep	to 19-Sep
12	15-Mar	to 21-Mar	39	20-Sep	to 26-Sep
13	22-Mar	to 28-Mar	40	27-Sep	to 03-Oct
14	29-Mar	to 04-Apr	41	04-Oct	to 10-Oct
15	05-Apr	to 11-Apr	42	11-Oct	to 17-Oct
16	12-Apr	to 18-Apr	43	18-Oct	to 24-Oct
17	19-Apr	to 25-Apr	44	25-Oct	to 31-Oct
18	26-Apr	to 02-May	45	01-Nov	to 07-Nov
19	03-May	to 09-May	46	08-Nov	to 14-Nov
20	10-May	to 16-May	47	15-Nov	to 21-Nov
21	17-May	to 23-May	48	22-Nov	to 28-Nov
22	24-May	to 30-May	49	29-Nov	to 05-Dec
23	31-May	to 06-June	50	06-Dec	to 12-Dec
24	07-June	to 13-June	51	13-Dec	to 19-Dec
25	14-June	to 20-June	52	20-Dec	to 26-Dec
26	21-June	to 27-June	53	27-Dec	to 31-Dec
27	28-June	to 04-July			

Appendix A.3. Scale sampling procedure showing the preferred area on a smolt salmon.



Appendix A.4.

SALMON SMOLT GLASS SLIDE EXAMPLE

The following information should be legibly written on the slide label:

1. AWL #
2. Location
3. date (mo/day/yr)
4. Fish # (1-5, 6-10, etc.)

AWL #009 RED LAKE 5/16/93 FISH 1-5	#1					#5

AWL #009 RED LAKE 5/16/93 FISH 6-10	#6					#10

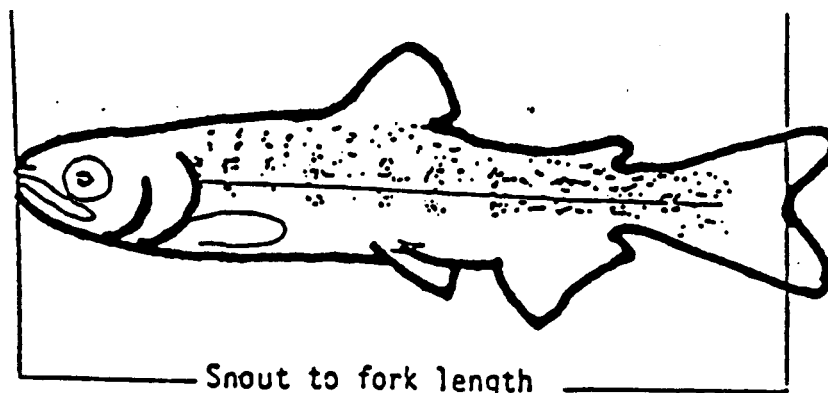
When the slides are completed, return them to the box in order by AWL # and fish#, and label the slide box on top with the following information:

Location (RED LAKE)
 AWL Numbers (AWL # 009 - 018)
 Beginning and ending dates (5/16 - 20/93)

cat. no. 48300-025	
VWR VWR VWR	micro slides
RED LAKE SmOLT.	
AWL : 009 - 018	
5/16 - 20/93	
VWR VWR	25 x 75 mm
VWR Scientific Inc. Media, PA. 19063	VWR Scientific A VWR COMPANY

Appendix A.5

MEASURING SMOLT LENGTH



A Guide to the Collection and Identification of Presmolt Pacific Salmon in Alaska with an Illustrated Key

MILTON B. TRAUTMAN¹

ABSTRACT

This field and laboratory key contains recommendations for types of equipment needed, instructions for preserving and labeling specimens, and descriptions of the characters used in identifying five species of Pacific salmon. The key is illustrated with six line figures: 1) juvenile salmon, 2) the first gill arch, 3) head with gill arch in situ, 4) first gill arch and eye for comparison with longest rakers, 5) method of counting anal fin rays, and 6) ventral surface of head showing branchiostegals. Five plates of stippled line drawings of five lengths (25 to 110 mm fork length) for each of the five species of Pacific salmon, an annotated opposable key, and a glossary are also included.

INTRODUCTION

As adults, the five species² of Pacific salmon of the genus *Oncorhynchus* inhabiting western North American waters are easily identified, but as subadults or as smolts in silvery coloration, they are less easily recognized. As juveniles less than 125 mm (5 inches) in fork length (FL), they may be quite difficult to identify. In addition, characters by which presmolt juveniles can be distinguished may vary with geographic area.

Several keys for identification of juvenile salmon have been published, most of which utilize the number, length, and shape of the gill rakers on the first gill arch; number of pyloric caeca and branchiostegals; and absence of parr marks, or if present, their size and shape (Foerster and Pritchard, 1935; Schultz, 1936; Haig-Brown, 1947; Clemens and Wilby, 1961; McPhail and Lindsey, 1970; Wilimovsky³). In addition to

the above characters, the key in this paper emphasizes and illustrates the distribution of those chromatophores (usually melanophores) which are reliable enough to aid in the specific identification of juveniles.

This key describes the characters typical of presmolt juveniles of the five species of Pacific salmon in Alaska. The common names recommended by the American Fisheries Society (Bailey et al., 1970, p. 17) are used, despite the fact that other names appear to be in more general use. These other names are inserted in parentheses after their respective species. Trouts, Atlantic salmon (*Salmo salar*), and some other salmonoids are included in the key because of their resemblance to Pacific salmon.

Before presenting the key, it appears advisable to describe the equipment and methods I recommend for preserving specimens, labeling specimens, and counting, measuring, and removing parts of specimens, so that those not acquainted with my procedures may more accurately and quickly identify their material.

¹ Professor Emeritus of Zoology, Ohio State University, Columbus, OH 43210. The author was employed in Alaska by the National Marine Fisheries Service, Auke Bay Fisheries Laboratory during the summers of 1959 and 1961. The specimens were obtained and most of the drawings made at that time.

² A sixth species, *O. masou* (Brevoort), inhabits the streams of eastern Asia from the Okhotsk Sea to Formosa.

³ N. J. Wilimovsky, 1958. Provisional keys to the fishes of Alaska. On file Natl. Mar. Fish. Serv., Auke Bay Fish. Lab., Auke Bay, AK 99821.

RECOMMENDED EQUIPMENT

Magnifiers: Magnification in the range of 4 to 30 will prove helpful in identification of juvenile salmon. A binocular microscope having such a range is the most satisfactory, but any type of magnifier of more than 4 power and less than 30 may be used provided it is not necessary to use one's hand to hold it—usually both hands are needed to manipulate a specimen. In the field, a binocular unit containing lenses inserted in a frame or headstrap or a jeweler's eye magnifier (especially if one wears glasses) may be used.

Forceps: Four or five inches long with straight or curved tips—for lifting fins, holding back gill covers, etc.

Scalpel: A sharp blade an inch or two long—for removing gill arches, opening body cavities, etc.

Teasing needle: A needle inserted in a wooden or metal handle—for separating closely set gill rakers, etc.

Dividers: For measuring and comparing various body parts; dividers in which one or both legs can be "broken" are the most satisfactory.

Scissors: About 6 inches long with the blades or cutting surface of about 1 inch.

Ruler: Graduated in millimeters to measure fish lengths and parts; one which includes inches also desirable.

PRESERVING SPECIMENS

The careful preserving of specimens cannot be too strongly emphasized. Much time is lost in attempting to identify improperly preserved fishes; it is only when properly preserved that they may be rapidly and correctly identified. Frequently, juvenile salmon that have died in nets become soft, bleached, and torn. For the sake of accuracy it is better not to attempt to identify such material.

To preserve juveniles, upon capture place them in a solution of 1 part Formalin to 9 parts water. If live fishes are placed in too strong a Formalin solution, they may die with their mouths widely agape or the chromatophores may close so tightly as to be difficult to detect. If placed in too weak a Formalin solution, the fishes become bleached and soft and may decompose. If fishes are to be preserved for more than a year (or permanently),

leave them in the Formalin solution at least 1 wk and if possible no longer than 4 mo. When fish are removed from the Formalin solution, soak them in water for 24 to 48 hr; then place them in a solution containing 70% ethyl alcohol and 30% water or 35% isopropyl alcohol and 65% water.

Do not crowd or pack fishes in a container, especially if they are alive or only recently dead. Fresh fishes, if packed too tightly, will become permanently deformed upon hardening in Formalin, will be bleached where their bodies come in close contact, or will decompose. A container is too crowded if the fishes will not readily move as the container is slowly rotated or shaken. When sufficient room is allowed, identification will be facilitated because the fishes will harden without discoloring; bodies and fins will not be deformed, twisted, or broken; and the chromatophores will remain nearly or fully open.

LABELING SPECIMENS

Labeling specimens fully and properly is of great importance; unlabeled or mislabeled specimens are of little or no value. Put the label with the specimens at the time the fishes are preserved. Label paper should remain firm when wet and should not become pulpy. Write clearly with pencil or permanent ink, recording the following data.

Field Number

Use your own or a department number. A satisfactory method is to use the first initial of your surname or your full surname, the last two digits of the year, and your collection number. Thus, if Joe Brown in 1962 preserves his fifth collection, he writes B-62-5 or Brown-62-5; if for the Department of Salmon Investigations he writes, SI-62-5. When a departmental symbol is used, it often is desirable for the collector to add his initials or name to the label.

Name of Water Body and Locality

Use names on standard maps. Whenever possible, avoid temporary or local names, such as

Brown's fishing camp. An example of a brief but adequate recording is: Alaska, Naknek River System, Katmai National Monument, Brooks Lake.

Date

Include the month, day, and year and, if pertinent, the hour.

The following additional information may be needed at times.

Method of Capture

Describe type of gear and size if significant, i.e., seine (2 cm mesh), fry net (1 cm mesh), trawl (1 cm bag), etc.

Temperature

Measure temperature of air and/or water. If water is ice-covered, what percent?

Other Water Conditions

If a *stream*: estimate its average width and maximum depth; if tidal and brackish, to what

extent; degree of turbidity and source—glacial silt, plankton, etc.; degree of gradient—low, moderate, or high; percentage of stream in pools, with or without current; percentage of stream in riffles, whether flow is sluggish, moderate, or swift; dominant bottom types—sand, gravel, boulders, bedrock, muck, silt, etc.; aquatic vegetation—submerged, emergent, or both (name dominant species or genera if known). If a *lake or bay*: state whether fresh, brackish, or saline; if tidal, state to what extent; estimate size and possible depth; give degree of turbidity, type of bottom, and amount and kinds of aquatic vegetation.

Remarks

Describe anything that may aid in identification of the fishes, such as peculiar markings, habits, or habitats.

CHARACTERS USED IN IDENTIFYING SPECIES

A juvenile salmon is shown in Figure 1 to assist in recognizing and defining the characters and the counts and measurements used when keying out a specimen.

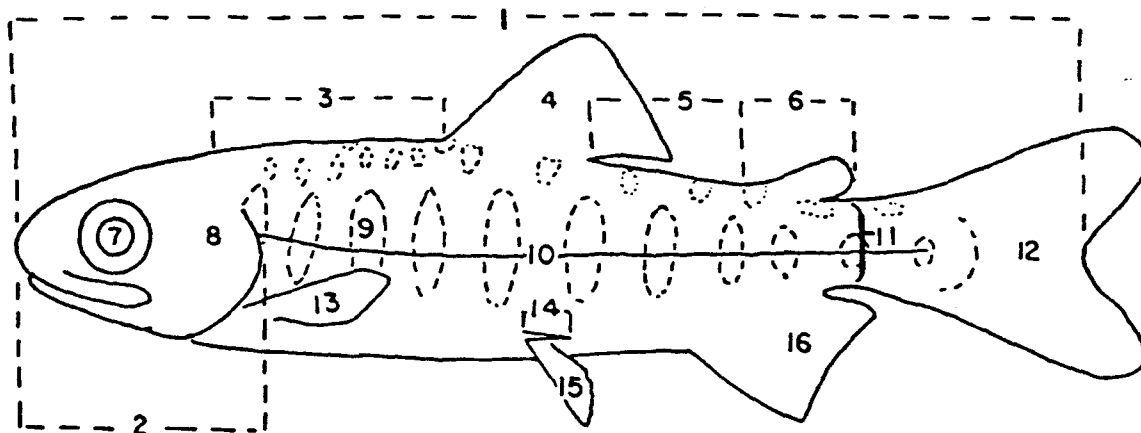
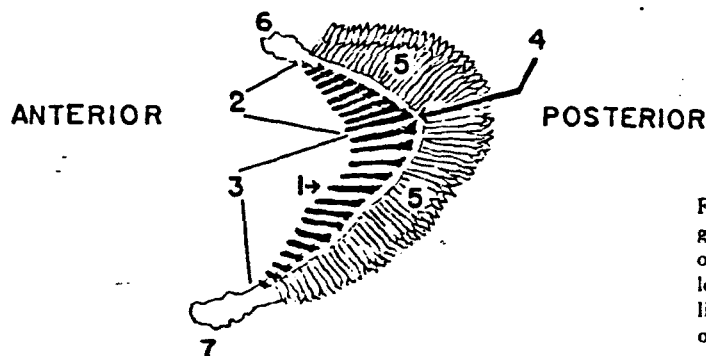


Figure 1.—Juvenile salmon, illustrating parts and methods of measuring: 1: fork length; 2: head length; 3: predorsal ridge; 4: dorsal fin; 5: portion of postdorsal ridge between posterior end of dorsal fin base and origin of adipose fin; 6: adipose fin; 7: pupil of eye; 8: gill cover, beneath which is gill chamber containing gill arches; 9: a parr mark; 10: lateral line; 11: caudal peduncle; 12: caudal fin or tail; 13: pectoral fin; 14: axillary process or scale; 15: pelvic fin; 16: anal fin.

First Gill Arch

Beneath each gill cover are four fully formed gill arches; the first gill arch on either side is the part used for specific identification. A gill arch (Fig. 2) consists primarily of a bony central arch to which the gill rakers are attached anteriorly, the gill filaments (lamellae) posteriorly. The gill rakers prevent solid substances such as food from being carried out through the branchial clefts and protect the delicate gill filaments. The numbers of gill rakers vary somewhat among individuals of each species of salmon, but the difference in average number between some species is sufficiently great to enable one to use them as specific characters.

The rakers on the gill arch may be counted as a unit, or the upper and lower limbs may be counted separately. The two limbs are joined



at an angle, the upper being the shorter. When a raker is situated astride the angle, it is included in the lower limb count. When all of the rakers on the arch are counted as a unit, a single number is given; otherwise, both limbs are recorded separately (the upper limb first), and then added, thus $12 + 20 = 32$.

The gill rakers nearest the angle of the arch are the longest; the rakers become progressively shorter as they approach the attachment ends of each arch. The rakers near the ends are often rudimentary and can be counted only under magnification.

It may be difficult to count all of the rakers accurately while the first gill arch is in place, in which case it will be necessary to remove the arch. To do this, turn back or cut away gill cover as shown in Figure 3. Lift the first gill arch up-

ward. With a sharp scalpel, cut between the dorsal ends of the first and second arches, making a deep incision parallel with them; then cut the remainder of the attachment away. Next cut the ventral attachment in the same manner; and when both ends are free, remove the arch. Great care must be taken so that all rudimentary rakers may be removed and counted. After finishing the examination of the arch, reinsert it in the gill chamber for possible future examination.

Gill Raker and Eye Comparison

The longest rakers are compared with the length of the eye (Fig. 4). With dividers, obtain the measurement of the length of the longest raker; then place one point of the dividers at the anterior edge of the eye, the other extending

Figure 2. — First gill arch of salmon after removal from left gill chamber: 1) gill raker; 2) gill rakers attached to upper or shorter limb of arch; 3) gill rakers attached to lower or longer limb of arch; 4) angle of arch (junction of the two limbs or bones); 5) gill filaments (lamellae); 6) upper point of arch attachment; 7) lower point of arch attachment.

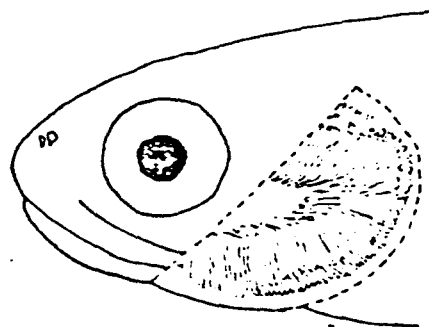


Figure 3. — Head of salmon. Dotted lines indicate that portion of gill cover which has been removed to show first gill arch in place.

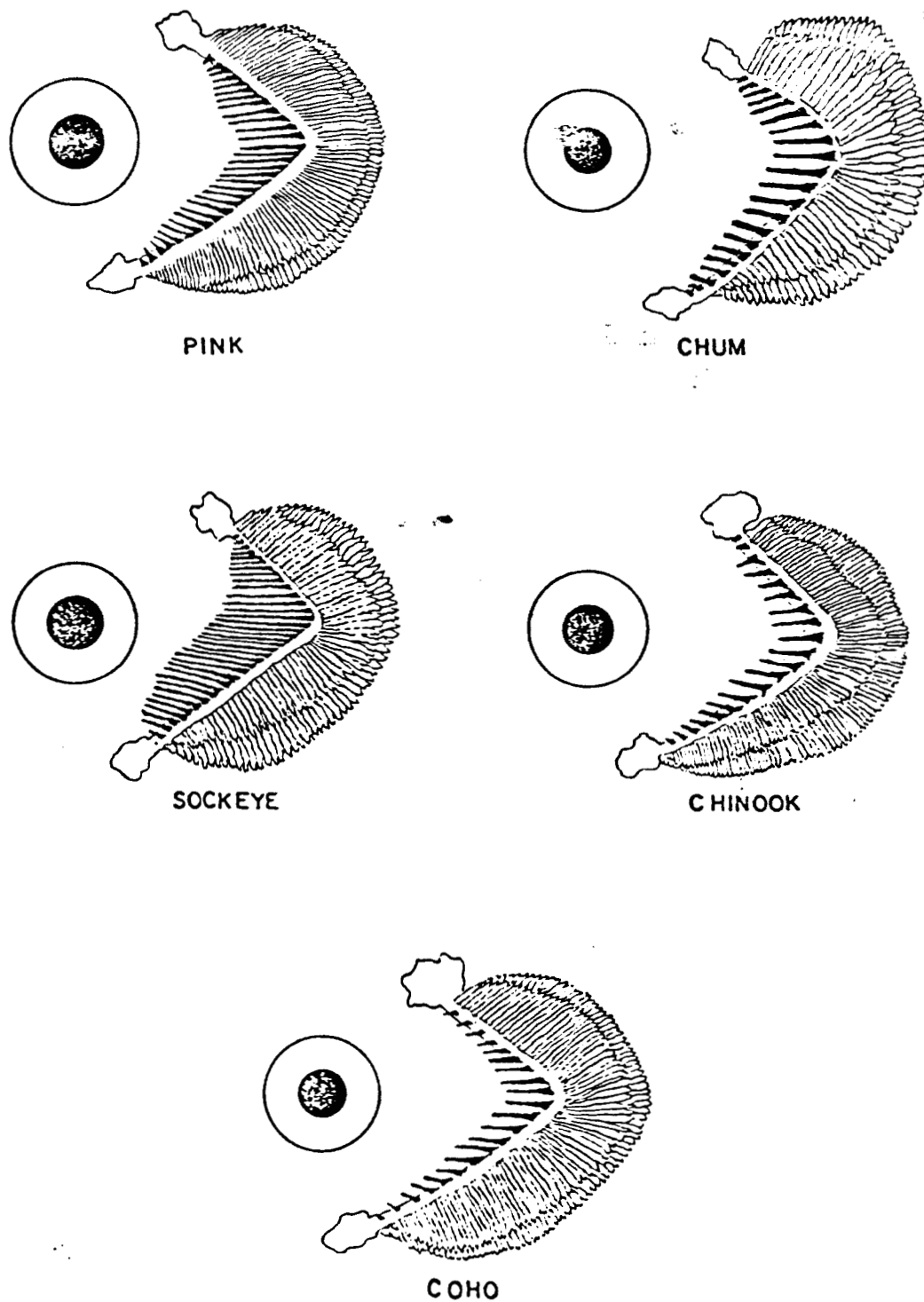


Figure 4. — First gill arch and eye for comparison with longest gill raker length of five species of Pacific salmon.

toward the opposite edge. Because the raker is shorter than the eye length in juvenile salmon, it is simplest to note where the raker reaches in relation to the pupil. Like many body part ratios, the gill raker-eye size ratios change as the juvenile salmon increases in length. For example, in specimens about 40 mm FL, the longest raker may be contained about 3 times the eye length, but in 140 mm specimens of the same species, the raker may be contained only about 2 times. This and other proportional changes must be considered.

Anal Fin Measurement and Count

To compare the length of the fin base with the longest ray, measure the anal fin base with dividers; then project the posterior leg of the dividers forward to the opposite tip of the longest ray as shown in Figure 5 by dotted line.

In counting the number of rays (Fig. 5), do not count those anteriormost ones which are less than half the length of the longest rays, such as those marked "0." Count all rays, such as No. 1, that are half (or more than half) the length of the longest ray, taking great care to observe the last ray—No. 15 in Figure 5. The last ray is usually split to its base and appears superficially as two rays, but it is in reality only one and should be counted as such.

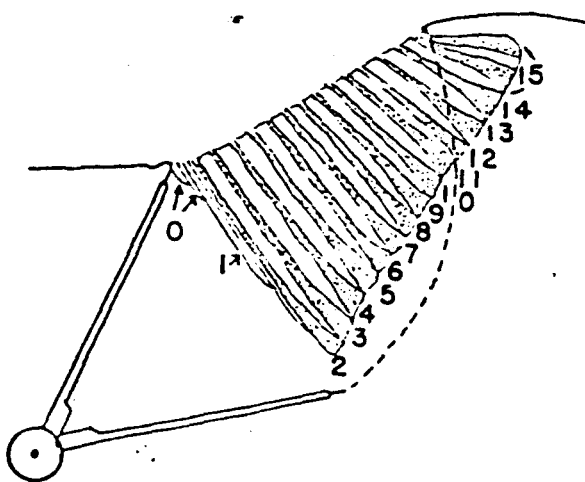


Figure 5.—Anal fin of salmon, illustrating method of measuring length of fin base and of counting rays (rays 2 to 15 are stippled here for emphasis).

Branchiostegal Count

All branchiostegals (Fig. 6), including the smallest, anteriormost ones are counted. Usually this may be accomplished satisfactorily only under magnification, and with juveniles longer than 40 mm FL. The branchiostegal count is used primarily as an additional character in specimens otherwise difficult to identify, and is especially valuable in separating the chinook salmon (usually 15 or 16) from the coho salmon (usually 13 or 14).

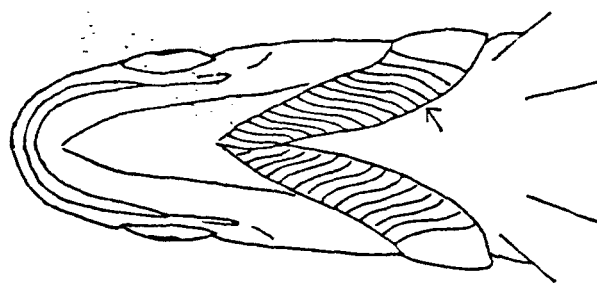


Figure 6.—Ventral surface of head of salmon. Arrow points to one of 14 branchiostegals on left side of head.

Pyloric Caeca Count⁴

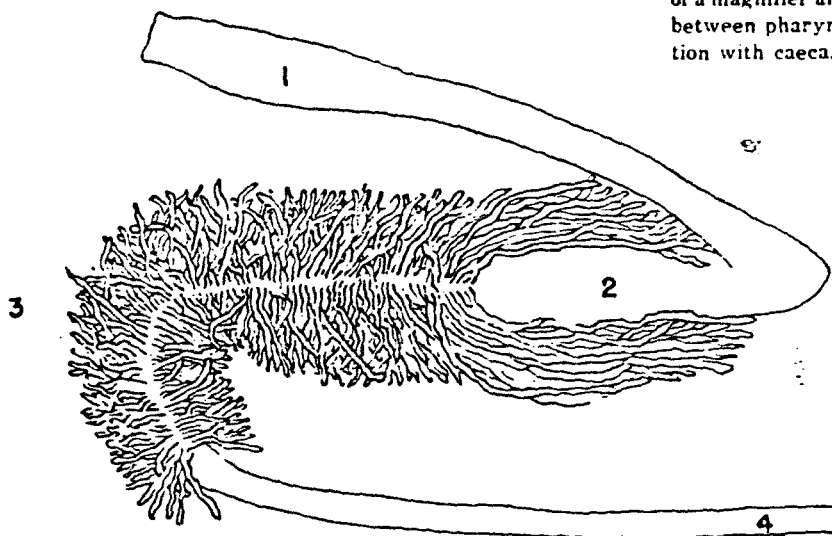
With a scalpel, widely open the abdominal cavity. Sever the esophagus as far forward as possible; then cut off the intestine near the posterior end of the stomach. The stomach and caeca can now be removed as a unit (Fig. 7). Use magnification and teasing needle as aids in counting. Counts of pyloric caeca are useful chiefly as an additional character for questionable specimens, especially in separating the chinook salmon (more than 100 caeca) from the coho salmon (fewer than 90).

Color Pattern Variations

Juvenile salmon from certain waters or at certain stages of development may have their parr marks or other markings masked by a bluish-

⁴In the key, I have used pyloric caeca counts of my own, plus published accounts of others and especially the more recent ones, such as Clemens and Wilby (1961) and McPhail and Lindsey (1970).

Figure 7. — Major portion of alimentary tract of salmon with pyloric caeca spread apart preparatory to counting with aid of a magnifier and teasing needle: 1) esophagus (part of tract between pharynx and stomach), 2) stomach, 3) pyloric section with caeca, 4) intestine.



or greenish-silvery sheen, especially when they are alive. To identify these fish, it may be necessary to preserve them first in Formalin to intensify their markings.

Juveniles of one species from certain waters, such as habitually turbid ones, may have their melanophores restricted in size or distribution, thereby resembling superficially another species. As an example, coho salmon normally have the adipose and anal fins densely speckled with rather large melanophores. But in some specimens, the melanophores may be reduced in size or distribution, so that coho salmon superficially resemble chinook salmon. Conversely, juvenile chinook salmon may have the melanophores unusually numerous and well developed, thereby resembling coho salmon. To avoid error in identification, compare the size and number of melanophores on the fins with those on the body; if few and small on the body, they should be few and small on the fins.

Color variations also occur regionally. An example is the predorsal stripe in chinook salmon, which in fish from some waters is normally a solid dark bar in specimens less than 80 mm FL; in chinook salmon in other waters the stripe may be reduced to a series of oblong blotches.

The length when individuals attain smolt coloration varies greatly, both regionally and in specimens from the same locality; some fish of

the same species may lose parr and other presmolt markings when only half as large as other fish.

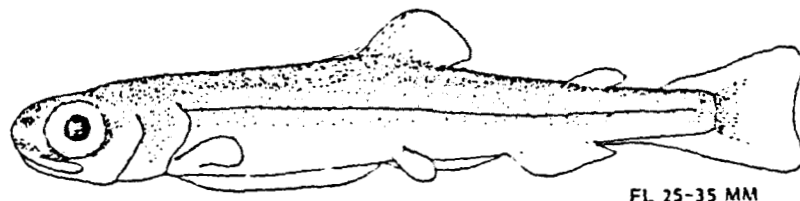
HOW TO USE KEY

Because of the variations in morphology and coloring, it is advisable to use the key in conjunction with the figures and plates and to check a large combination of characters.

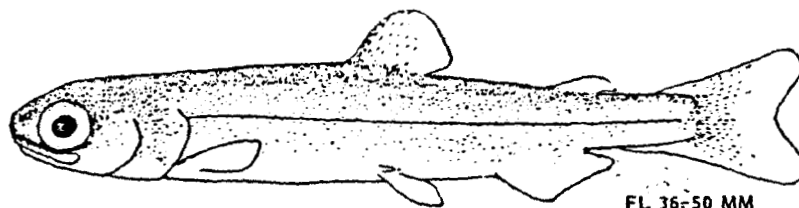
In using the key, first make certain your specimen is a Pacific salmon by examining the characters under the two opposable groups labeled "1." Next, note the absence or presence of parr marks (see sections "Combination of" under opposable groups 2). If no parr marks are present and your specimen has not entered the silvery smolt stage, it is probably a pink salmon, but to make sure, compare it with the identifying characters between opposable groups 2. If parr marks are present, note the absence or presence of melanophores on adipose and anal fins (see groups 3). If melanophores are absent, see sections "Combination of" under groups 4; if present, see "Combination of" sections under groups 5. Decide which "Combination of" most closely fits your specimen, then verify it by comparing the descriptions of the identifying characters for the opposable groups.

KEY TO PRESMOLT JUVENILE SALMON

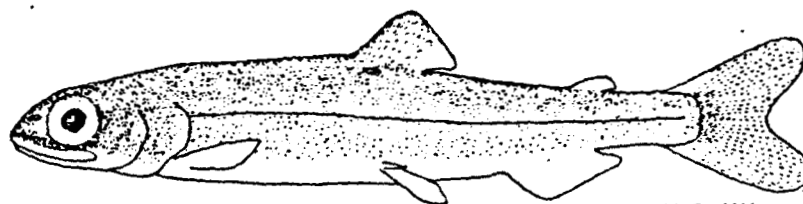
- Salmonoid fishes having fewer than 20 rays in the dorsal fin (excludes grayling); strong teeth on jaws and tongue (excludes ciscoes and whitefishes); many pyloric caeca (excludes smelts, family Osmeridae); an axillary process or scaly appendage above pelvic fin (Fig. 1, No. 14); an adipose fin; cycloid scales; upper jaw formed by both premaxillary and maxillary1.
- Base of anal fin *shorter* than longest ray (Fig. 5). Anal rays usually 9 to 12 (rarely 8 or 13). Gill rakers normally fewer than 20 on first gill arch (Fig. 3). Dorsal fin of larger juveniles of some species with several blackish spots.
- 1a CHAR, TROUTS, ATLANTIC SALMON.Not in this key.
- Base of anal fin *longer* than longest ray (Fig. 5). Anal rays usually 13 to 17 (rarely 12, 18, or 19). Gill rakers normally 20 to 40 on first gill arch (rarely 19). Dorsal fin of larger juveniles lack blackish spots but tip of fin may be blackish.
- 1b PACIFIC SALMON—genus *Oncorhynchus*.2.
- Combination of: No parr marks on sides and no prominent specklings on back of presmolt juveniles. Usually no melanophores on anal and adipose fins; if melanophores present, they are few and very small, and if on adipose, are restricted to its posterior, free edge.*
- 2a PINK (HUMPBACK) SALMON—*O. gorbuscha*.Plate 1.
- General development—Similar to chum salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape and coloration is rapid. When less than 50 mm FL, this species is similar to chum salmon in being more terete than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually more than 1.5 times head length.
- Parr marks—Only species of salmon lacking parr marks in the presmolt juvenile.
- Coloration of body—*Preserved material*—In juveniles less than 40 mm FL, back is dark to lateral line and ventral half of body light when bicolored; dorsal third of body is darkest, sides lighter, ventral third lightest (usually milky-white or silvery) when tricolored. Few or no melanophores on lower sides and belly. In juveniles more than 40 mm FL, bicolored or tricolored condition is normally not evident, the dark back lightening gradually downward to the very light belly. *Living specimens*—Dorsal half of body bright bluish or greenish with much silvery reflection; ventral half milky or silvery-white.
- Fins—Anal and dorsal fins averaging smaller than in chum salmon; these fins in this species and in chum salmon distinctly smaller than in sockeye, chinook, or coho salmon. In specimens less than 40 mm FL the longest anal ray, when measured into head length, extends from tip of snout to about center of eye; in larger presmolt juveniles, this measurement extends from tip of snout to anterior half of eye. Anal rays usually 14 to 16 (extremes 13 to 17). *Dorsal fin* has few specklings and only a slight tendency toward a dark anterior edge in juveniles less than 50 mm FL; over 50 mm, blackish anterior edge becomes pronounced and tip of fin dusky. *Caudal fin* has speckling confined to basal half in juveniles less than 50 mm; with increasing length of juveniles, specklings appear along rays, and in large presmolt juveniles lobes tend to become blackish.



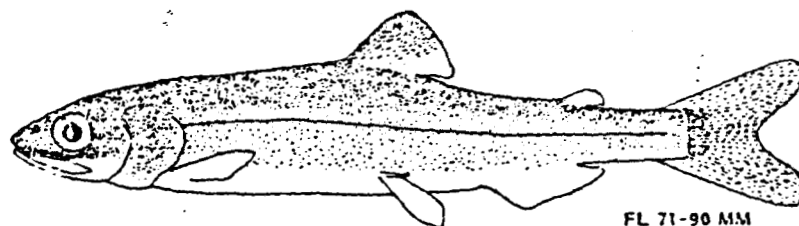
FL 25-35 MM



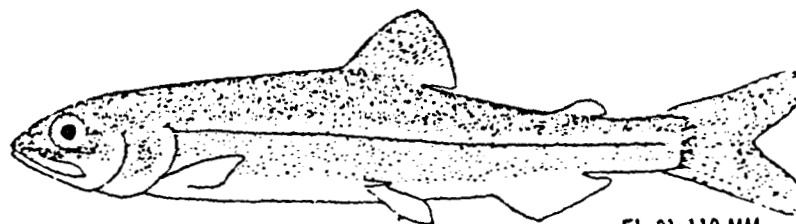
FL 36-50 MM



FL 51-70 MM



FL 71-90 MM



FL 91-110 MM

Plate 1.—Pink salmon.

- Gill rakers (see Fig. 4) — Eleven to fourteen on upper limb, 14 to 19 on lower, total usually ranging between 27 and 33 (extremes 25 and 35); rakers slender and rather long; most similar in size and number to sockeye salmon but shorter and usually fewer (normally less than 31).
- Pyloric caeca— Usually 130 to 195 (extremes 95 to 224); slender and rather long; differ sufficiently in numbers from coho and sockeye salmon, which have fewer than 100, to be a distinct aid in specific identification.
- Branchiostegal rays— Usually 11 to 14 (rarely 10 or 15); average number less than in other species, almost invariably less than in chinook salmon, which usually has 15 to 18 (rarely 14).
- Scales in lateral line— More than 170, more than in any other of the Pacific salmon; lateral line scale counts may be obtained under magnification in specimens longer than 60 mm FL.
- Habits— Shortest life span of any species, between 18 mo and 2 yr. Only a comparatively small proportion of adults make extended migration in fresh water. Majority spawn in fresh waters within a short distance of brackish water or in intertidal waters. Many young enter brackish or salt waters within a few hours or days after emerging from redds, and comparatively few are found in fresh water when more than 45 mm FL.
- Combination of:** Both parr marks on sides and dark spottings on back usually obvious in living, presmolt juveniles and always in preserved specimens under magnification (may be faint in fishes from turbid waters); parr marks become faint and disappear as juvenile assumes smolt coloration3.
- 2b
- No melanophores** normally present on adipose and anal fins of presmolt juveniles, or if present, few and quite small. Parr marks occupy a larger area above lateral line than below it, and in some specimens anterior parr marks may be almost entirely above the lateral line.
- 3a
- CHUM AND SOCKEYE SALMON**4.
- Melanophores** normally obvious on adipose fin in living specimens and always in preserved specimens under magnification (may be indistinct in juveniles from silty waters). Anteriormost parr marks appear to occupy as large (or almost as large) an area below lateral line as above it; these parr marks are usually large, long, and wide.
- 3b
- CHINOOK AND COHO SALMON**5.
- Combination of:** Gill rakers 19 to 26 (average 23), notably fewer and much shorter than in sockeye salmon, which have more than 28. Normally *no* melanophores on adipose and anal fins. Anterior squarish (quadrate) parr marks situated almost or entirely above lateral line in specimens less than 50 mm FL; in presmolt juveniles more than 50 mm FL, anterior parr marks tend to be long and very narrow and sometimes may extend well below lateral line.
- 4a
- CHUM (DOG) SALMON—*O. keta***Plate 2.
- General development — Similar to pink salmon in that yolk sac may not disappear until juvenile is more than 34 mm FL, after which development toward smolt shape is rapid. Also similar to pink salmon in being more terete (when less than 50 mm FL) than the sockeye, chinook, and coho salmon; body depth immediately before dorsal fin usually 1.5 to 1.8 times head length.

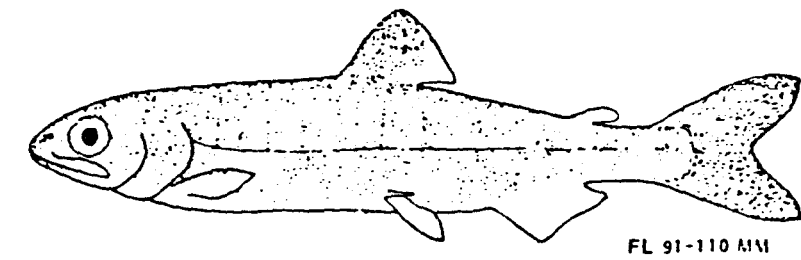
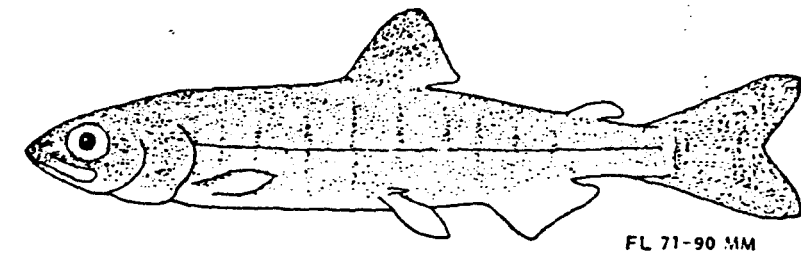
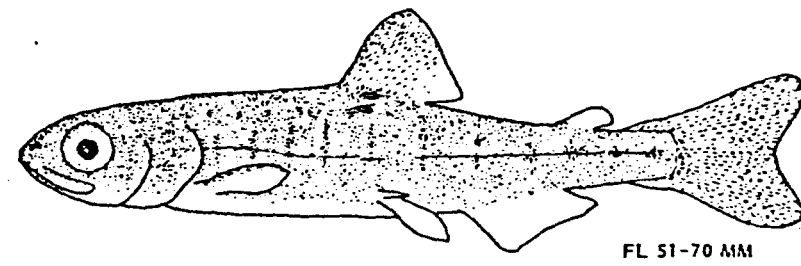
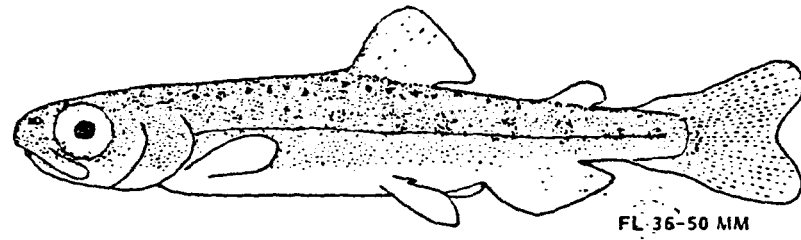
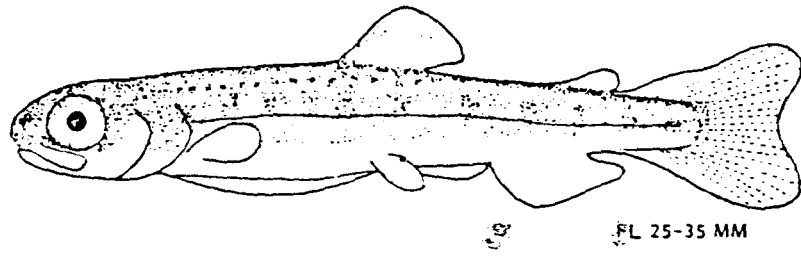


Plate 2.—Chum salmon.

Parr marks—Anterior parr marks in specimens less than 50 mm FL are more squarish (quadrangle) and do not extend quite so far below lateral line as in sockeye salmon; in presmolt juveniles more than 50 mm FL, parr marks tend to become longer and more narrow than in sockeye salmon, and some tend to extend well below lateral line.

Coloration of body—*Preserved material*—Dorsal ridge stripe usually present, sometimes a series of blotches in juveniles less than 50 mm FL, becoming faint or disappearing in presmolt juveniles more than 50 mm FL; a prominent irregular row of spots and blotchings between dorsal ridge and upper edge of parr marks, these usually most distinct in specimens between 34 and 50 mm, often fading or disappearing in larger juveniles. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins small, averaging slightly larger in size than those of pink salmon and averaging considerably smaller in height and area than those of sockeye salmon. Length of longest anal ray, when measured from snout to eye, reaches to, or almost to, center of eye; in sockeye salmon this measurement usually extends well beyond center of eye. Anal rays usually 13 or 14 (extremes 13 to 17). *Dorsal fin* has few or no distinct spottings in specimens less than 50 mm FL; in larger presmolt juveniles a dusky spot develops on tip. *Caudal fin* has faint spots largely confined to basal half in juveniles less than 50 mm FL; in larger juveniles lobes become blackish.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 12 to 19 on lower, total usually ranging between 20 and 26 (extremes 19 to 30); rakers blunt and short, in sharp contrast to thinner, longer, and more numerous rakers of sockeye salmon, which has 30 to 39.

Pyloric caeca—Usually 160 to 185 (extremes 140 to 249); differ sufficiently in numbers from sockeye and coho salmon, which usually have fewer than 100, to be an aid in specific identification.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 16); of value primarily in separating this species from chinook salmon, which generally has more than 15.

Scales in lateral line—Between 125 and 155; of value chiefly in separating this species from pink salmon.

Habits—Life span usually 3 to 5 yr, for majority, 4 yr, some less than 3 yr. Jacks may occur. Majority spawn in fresh waters only a comparatively short distance from brackish water or in intertidal waters. Many young enter brackish or salt waters very shortly after emerging from redd, and few juveniles are found in fresh waters when more than 45 mm FL.

4b *Combination of*: Gill rakers 30 to 39 (average 36); notably more numerous, longer, and more slender than in chum salmon, which have fewer than 27. Normally no melanophores on adipose and anal fins. Anterior parr marks more rectangular than squarish in outline in specimens less than 45 mm FL and sometimes extend as much as a third to a half below lateral line; these oblong parr marks tend to shorten in presmolt juveniles more than 50 mm FL and to be mostly above lateral line.

SOCKEYE (RED) SALMON—*O. nerka*. Plate 3.

General development—Yolk sac usually disappears, except for trace, before juveniles reach 30 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon—body depth immediately before dorsal fin usually less than 1.5 times head length.

Parr marks—See "*Combination of*" above.

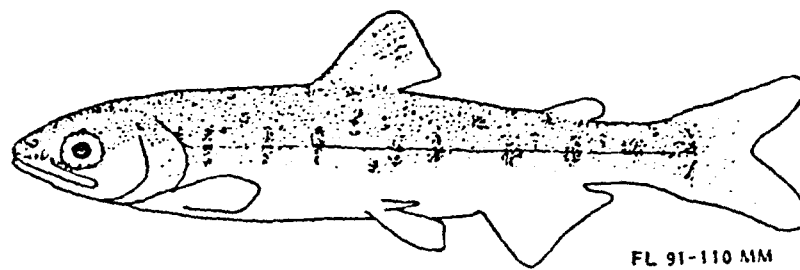
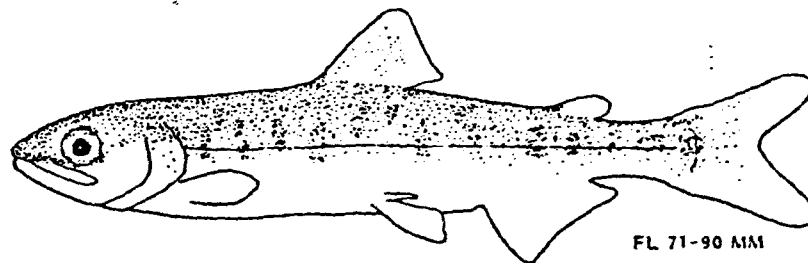
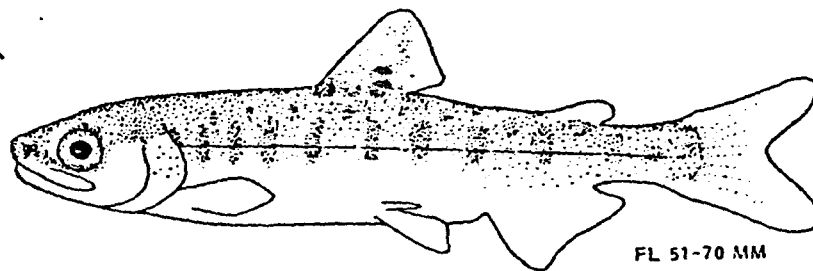
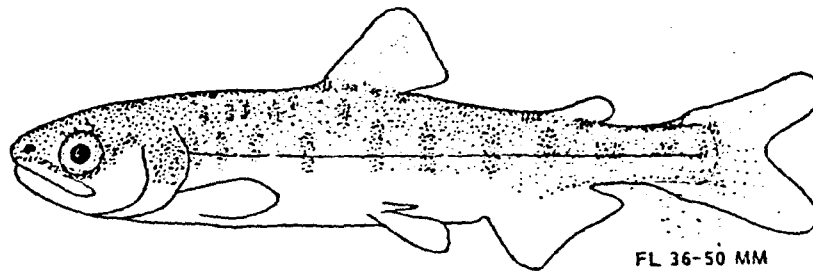
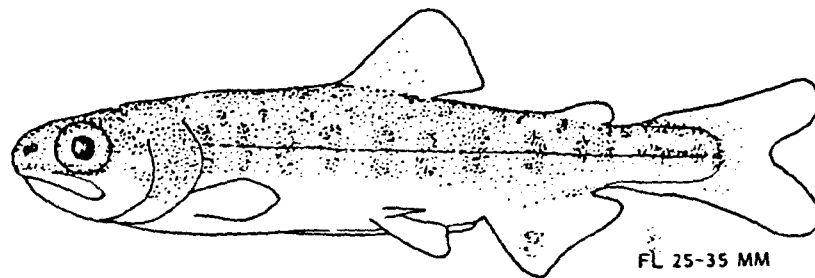


Plate 3. — Sockeye salmon.

Coloration of body—*Preserved material*—Dorsal ridge usually contains a series of more or less distinct spots in specimens less than 35 mm FL, becoming more confluent in fishes between 40 and 55 mm FL and sometimes merging into a dusky bar; in presmolt juveniles over 60 mm FL, spots or bars may disappear, after which a series of roundish spots become apparent on both sides of, and adjacent to, dorsal ridge, especially that portion behind dorsal fin; in addition to these spots, in fishes more than 35 mm FL, another longitudinal row of spots develops between dorsal ridge and upper halves of parr marks. *Living specimens*—Markings may be obscured by greenish or bluish overcast of dorsal half of body and whitish or silverish sheen of ventral half.

Fins—Anal and dorsal fins average larger in height and area than in chum and pink salmon. Length of longest anal ray, when measured from snout to eye, reaches usually from snout to beyond center of eye. Anal rays usually 14 to 16 (extremes 13 to 16). *Dorsal fin* normally has few or no distinct specklings in specimens less than 60 mm FL; a rather faint dorsal spot develops in larger presmolt juveniles in upper portion of fin, the fin being bordered on its free edges with whitish (see lowest figure, Plate 3). *Caudal fin* has few specklings on basal half, the lobes having few or no melanophores, even in rather large juveniles.

Gill rakers (see Fig. 4)—Twelve to sixteen on upper limb, 18 to 23 on lower, total usually ranging between 32 and 37 (extremes 30 to 39); rakers long and slender, averaging longer than in any other species, in sharp contrast to fewer, blunter rakers of chum salmon, which has 19 to 30.

Pyloric caeca—Usually 65 to 95 (extremes 45 to 115); usually considerably fewer than in pink, chum, and chinook salmon, and averaging more than in coho salmon.

Branchiostegal rays—Usually 13 to 15 (extremes 11 to 16); of value chiefly in separating this species from chinook salmon, which average more.

Scales in lateral line—Between 125 and 140; of value chiefly in separating this species from pink salmon, which has a higher number.

Habits—Life span usually 4 or 5 yr, some only 3. Jacks may occur. Majority of individuals highly migratory. Adults usually spawn in streams tributary to lakes; a small minority spawn in streams without a lake, in lake outlets, or on lake beaches. After rising from redd, young move downstream rather rapidly to a lake, remaining usually 1, sometimes 2, and rarely 3 yr in fresh water before entering brackish or salt water.

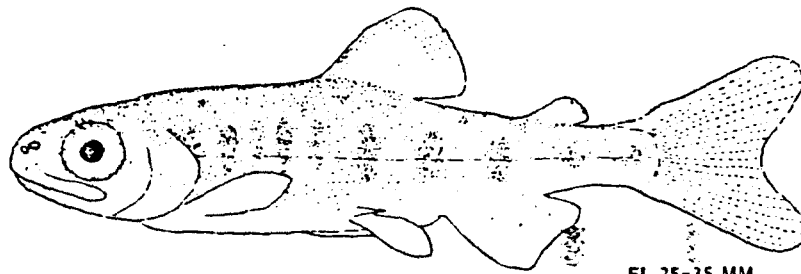
5a

Combination of: Melanophores on adipose fin usually most numerous on posterior half and generally forming a dark border (see Plate 4); anterior half of adipose with few melanophores or none. Anal fin with few melanophores or none, but when melanophores are present, often quite large. Tip of dorsal fin and lobes of caudal fin darker in larger presmolt juveniles.

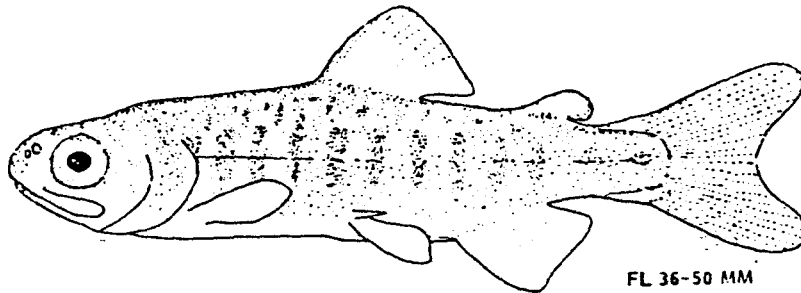
CHINOOK (KING) SALMON—*O. tshawytscha*. Plate 4.

General development—Yolk sac usually disappears or is reduced to a trace before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all presmolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 1.1 to 1.5).

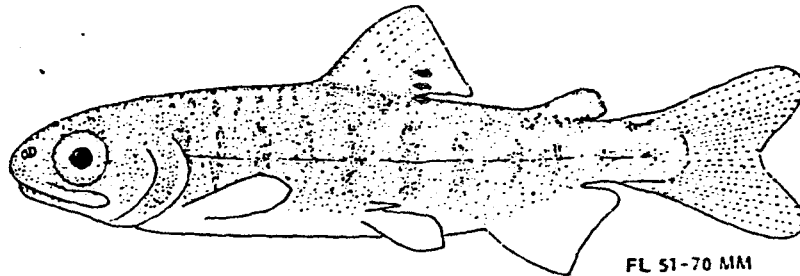
Parr marks—Almost invariably rectangular and long vertically; marks usually situated equidistant on each side of lateral line; dark parr marks and other markings contrast sharply with lighter background of body in some living and most preserved specimens.



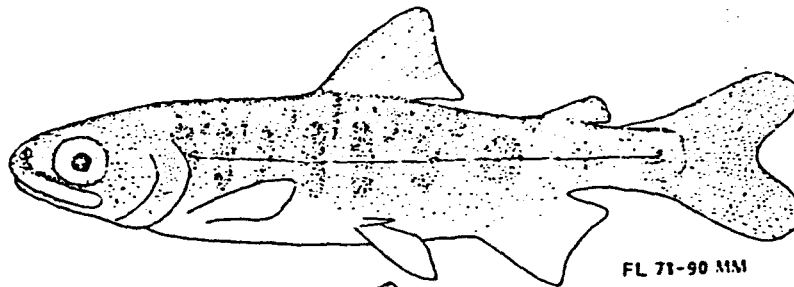
FL 25-35 MM



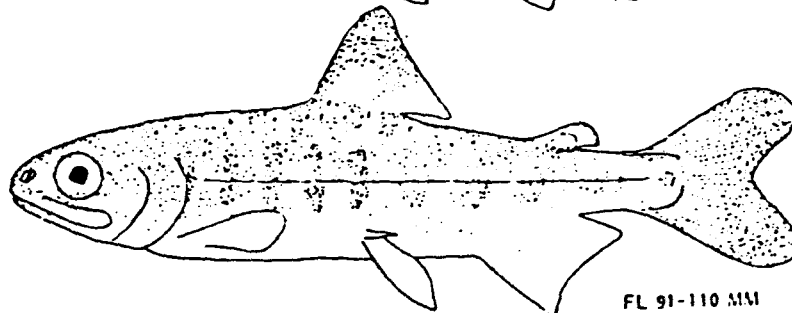
FL 36-50 MM



FL 51-70 MM



FL 71-90 MM



FL 91-110 MM

Plate 4.—Chinook salmon.

Coloration of body—*Preserved material*—Background color of body generally much lighter than body color of coho salmon, usually contrasting sharply with dark dorsal stripe or spotting, parr marks, and prominent dorsal spottings; blackish band astride dorsal ridge usually bold and unbroken in specimens less than 80 mm FL and especially on ridge before dorsal fin; in larger juveniles dorsal band often breaks up into series of spots, disappearing in larger pre-smolts as other spottings on dorsal half of body become more numerous and distinct; spottings between dorsal ridge and parr marks absent in fishes less than 35 mm FL, developing rapidly thereafter into many large and small spots and increasing in numbers as juveniles approach smolt stage. *Living specimens*—Parr marks and other markings may be obscured by bluish-silvery color of dorsal half of body and silvery sheen of ventral half.

Fins—Anal and dorsal fins averaging considerably larger in area than those of the chum and pink salmon and slightly larger than in the sockeye salmon; length of longest anal rays, when measured into head length, reaching from snout tip to beyond posterior edge of pupil and sometimes beyond posterior edge of eye; distal edge of anal slightly falcate in specimens more than 40 mm FL but averaging less falcate than does the free edge of the anal of the coho salmon. Anal rays 15 to 19, averaging higher in number than in any other species. *Dorsal fin* in young less than 60 mm FL usually has few or no distinct spottings, a blackish spot developing in the upper portion of the fin as the juveniles approach the smolt stage (see Plate 4). *Caudal fin* has comparatively few melanophores rather generally distributed in the smaller individuals, the lobes darkening as the fishes approach the presmolt stage.

Gill rakers (see Fig. 4)—Seven to twelve on upper limb, 10 to 16 on lower, total usually ranging between 20 and 25 (extremes 19 to 28); rakers short and similar in size and number to chum and coho salmon.

Pyloric caeca—Usually 140 to 185 (extremes 90 to 240); of value in separating this species from coho salmon, which normally has fewer than 85.

Branchiostegal rays—Usually 16 to 18 (extremes 13 to 19); average number greater than in any other species.

Scales in lateral line—Between 132 and 152; usually of most value in separating this species from pink salmon.

Habits—Life span 2 to 8 yr, usually 4 to 6. Jacks may occur. A portion of the juveniles enter salt water during first year of life; remainder stay in fresh waters more than 1 yr but rarely 2 yr. Juveniles of presmolt stage found in fresh waters when as long as 150 mm FL.

Combination of: Melanophores usually numerous and rather evenly distributed on adipose fin; occasionally in larger juveniles, posterior or free edge may be darker than remainder, thereby resembling somewhat melanophore distribution on adipose of chinook salmon. Anal fin in specimens larger than 30 mm FL more falcate and anterior tip more pronounced than in other species, including chinook salmon; in all except smallest specimens, anterior or leading edge of anal fin is whitish, with a dark bar parallel and posterior to it; remaining, posterior portion of fin usually abundantly speckled with melanophores except for distal and posterior edges (see Plate 5).

COHO (SILVER) SALMON—*O. kisutch*. Plate 5.

General development—Yolk sac usually disappears, except for a trace, before juveniles reach 32 mm FL. Body deeper and species more slab-sided in all pre-

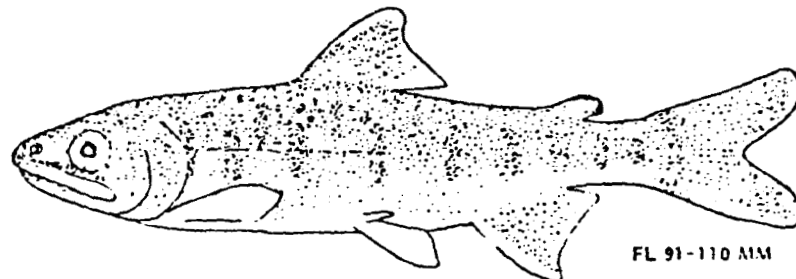
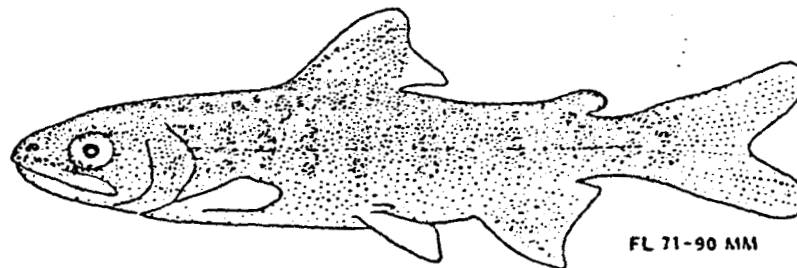
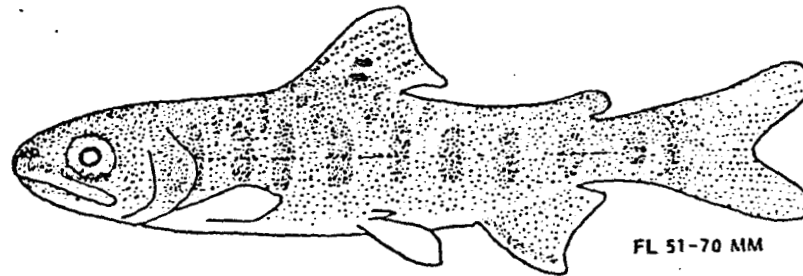
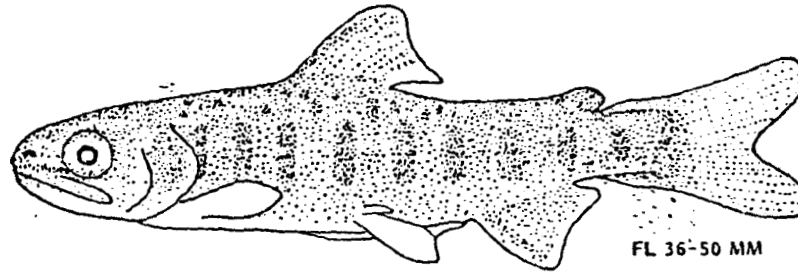
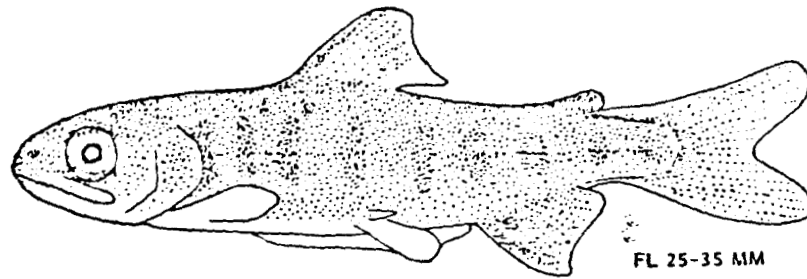


Plate 5. — Coho salmon.

smolt lengths than in chum and pink salmon; body depth immediately before dorsal fin usually less than 1.5 times head length (range 0.9 to 1.5).

Parr marks—Anterior parr marks always large and long vertically, their upper and lower ends more rounded than rectangular-shaped parr marks of chinook salmon; marks usually situated equidistant on each side of lateral line; usually less contrast between color of parr marks and body than in chinook salmon.

Coloration of body—*Preserved material*—In all but smallest specimens, contrast between all body marks and background color of body is not as pronounced as in other species; dark bar along dorsal ridge usually distinct and unbroken in juveniles less than 50 mm FL, breaking up into spots or disappearing in larger specimens; back spottings on both sides of dorsal ridge usually prominent in all except smallest specimens; spots between parr marks often elongate and extending downward between them, sometimes to lateral line (see bottom figure, Plate 5); spots on dorsal half of body often increase in number and/or decrease in size as individuals approach smolt stage. *Living specimens*—Parr marks and other body markings may be obscured by dark coloration of body or by bluish sheen.

Fins—Anal and adipose fins described under "Combination of" (this section). Anal rays usually 13 or 14 (extremes 13 to 16). *Dorsal fin* has comparatively few melanophores scattered over it in smallest specimens; in those more than 32 mm FL the number of melanophores increases, especially on or adjacent to anterior or leading edge; this results in a dark bar along the anterior edge behind which melanophores are rather evenly distributed; as fishes approach presmolt stage, a white anterior (or leading) edge and a whitish tip develops, followed by a dark parallel bar (see bottom figure, Plate 5). *Caudal fin* has rather even distribution of melanophores along rays in all except smallest young, this increasing in color intensity and number as fish increases in size.

Gill rakers (see Fig. 4)—Eight to thirteen on upper limb, 9 to 14 on lower, total number usually ranging between 19 and 27 (extremes 18 to 27); rakers short and rather similar in size and number to chum and chinook salmon.

Pyloric caeca—Usually 50 to 85 (extremes 45 to 114); of value in separating this species from chinook, pink, and chum salmon, which normally have more than 100.

Branchiostegal rays—Usually 13 or 14 (extremes 12 to 15); average number less than in chinook salmon, which normally has 15 or more.

Scales in lateral line—Between 120 and 140 (average 128); usually averaging fewer than in any other species.

Habits—Life span 2 to 4 yr. Jacks may occur. Majority appear to spend 1 or 2 yr in fresh waters, a few 3 yr. Some juveniles in presmolt stage are found in fresh waters when 150 mm FL.

GLOSSARY

- Adipose fin** A fleshy, finlike, rayless structure situated on dorsal ridge between dorsal and caudal fins (Fig. 1, No. 6).
- Anal fin** The fin situated medially and immediately behind vent between posterior end of abdomen and anterior end of caudal peduncle (Fig. 1, No. 16).
- Axillary process or scale** An accessory enlarged scale attached to upper or anterior base of pelvic fin (Fig. 1, No. 14).
- Gill opening** Opening between opercle or gill cover and side of head.
- Branchiostegals or branchiostegal rays** Elongated bones arranged fanwise within branchiostegal membranes, situated on ventral edge of gill covers (Fig. 6).
- Caudal fin** Terminal or tail fin of fishes (Fig. 1, No. 12).
- Caudal peduncle** That region of body between base of posterior ray of anal fin and base of caudal fin (Fig. 1, No. 11).
- Chromatophores** Color cells which under control of sympathetic nervous system can be altered in shape, producing color changes.
- Cycloid scales** Smooth-edged scales of soft-rayed fishes having an evenly curved posterior border devoid of minute spines.
- Dorsal fin** In salmon, a single fin composed of rays situated dorsally on body approximately halfway between head and tail (Fig. 1, No. 4).
- Dorsal ridge** Apex or dorsal junction of left and right sides of body; dorsal and adipose fins are situated on this ridge (Fig. 1, No. 3-6).
- Dorsal stripe** A band on dorsal ridge which is lighter or darker than adjacent areas.
- Falcate** Curved like a sickle; a fin is falcate when its distal edge is concave, having middle rays shorter than anterior and usually posterior rays.
- Filaments** See *gill filaments*.
- Fork length** Distance in a straight line from anteriormost part of tip of upper jaw or snout of juvenile salmon to apex of angle produced by two lobes of caudal fin (Fig. 1, No. 1).
- Gill arch** Branchial skeleton which contains gill rakers and gill filaments, or lamellae (Fig. 2).
- Gill cover, opercle, or operculum** Large, very flat, thin bones on each side of head which cover gills (see Fig. 3, which has the major portion of the gill cover removed).
- Gill filaments (lamellae)** Pleated folds of skin, richly supplied with blood vessels, attached to posterior edge of gill arch (Fig. 2, No. 5).
- Gill rakers** Projections on anterior edge of first gill arch (Fig. 2, No. 1).
- Head length** Distance in a straight line from anteriormost part of upper jaw or snout to posterior margin of opercle (Fig. 1, No. 2).
- Hypural** Complex of expanded and fused bones of last few vertebrae which support caudal fins in certain fishes.
- Jack** Precocious male salmon which spawn after spending a year or two less in the ocean than the majority of individuals; they are notably smaller than average size of spawning males of their species.
- Juvenile** As used here, a salmon between 25 and 110 mm FL which has not entered smolt stage.
- Lamellae** See *gill filaments*.
- Lateral line** A line formed by a series of sensory tubes and pores extending along sides from head to tail (Fig. 1, No. 10).
- Lateral line scale count** A count of pored scales from first scale on body behind head posteriorly to above hypural.
- Melanophores** Chromatophores with dark or black pigment.
- Parr marks** Squarish or oblong blotches or pigmented areas along sides of presmolt salmonids (Fig. 1, No. 9).
- Pectoral fins** Anterior or uppermost of paired fins of fishes, one on each side of breast immediately behind head (Fig. 1, No. 13).
- Pelvic fins** A ventral pair of fins, abdominal in salmonids (Fig. 1, No. 15).
- Postdorsal ridge** That portion of dorsal ridge behind dorsal fin (Fig. 1, No. 5).
- Predorsal ridge** That portion of dorsal ridge before dorsal fin (Fig. 1, No. 3).
- Presmolt** A juvenile salmon with parr marks; in pink salmon, which lack parr marks, demarcation between a presmolt and smolt is slight, differing chiefly in latter's more adult shape.
- Pupil of eye** Opening in iris of eye by which light reaches retina. It is circular in fishes (Fig. 1, No. 7).
- Pyloric caeca** Fingerlike diverticula, usually glandular, which open into alimentary canal

of most fishes at junction of stomach and intestine in region of pylorus (Fig. 7, No. 3).

Rakers See *gill rakers*.

Redd Excavation or nest made by a spawning salmon.

Rudimentary Very small and poorly formed, pertaining here chiefly to smallest gill rakers and anal rays (Fig. 5, "0").

Slab-sided When depth of body, measured before dorsal fin, is considerably greater than width of body.

Smolt As used here, a young salmon which has lost its parr marks. Pink and chum salmon fry usually go to the ocean within a few days of emerging from the streambed and usually do not undergo a visible change in morphology or color in fresh water.

Subadult An individual similar to an adult and approaching adulthood in age and size but still incapable of breeding.

Terete Nearly cylindrical in cross section and tapering toward the front and rear.

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Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish¹ that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alter-

native characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics—and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

KEY

1. (47) Adipose fin and scales present.
(Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

¹ Especially adult smelt, family Osmeridae.

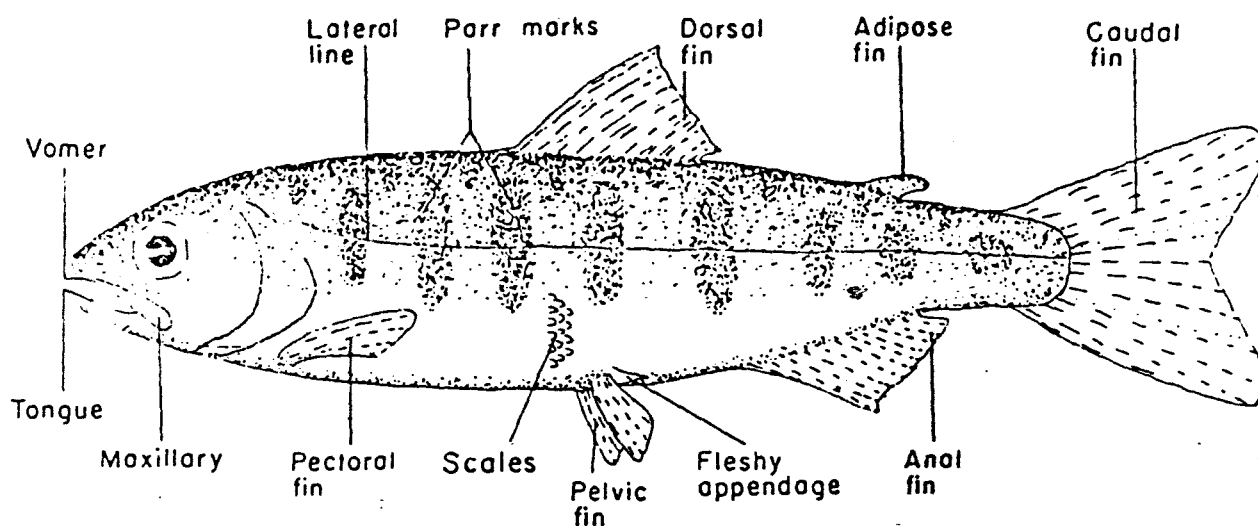


Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

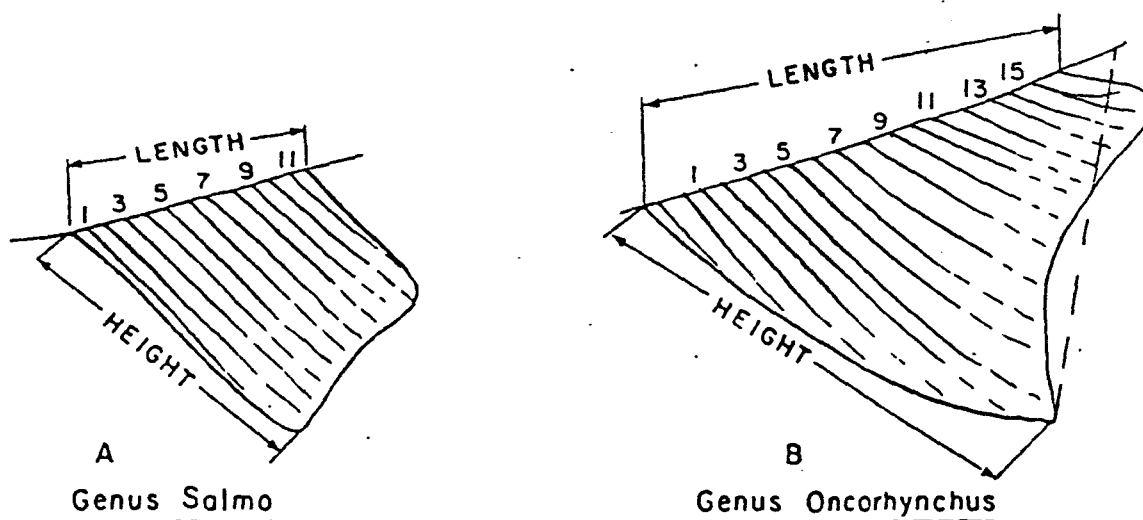


Figure 2.—Anal fins: (A) Trout, genus *Salmo*; (B) Pacific salmon, genus *Oncorhynchus*. The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

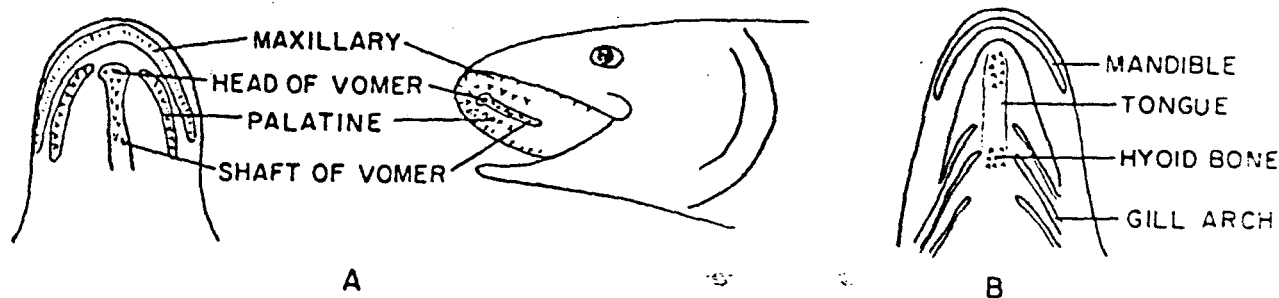
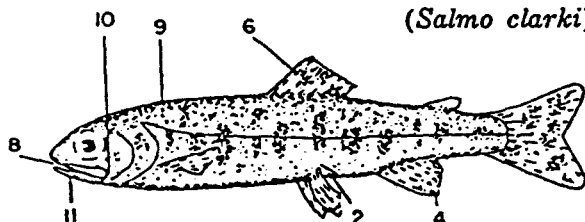


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

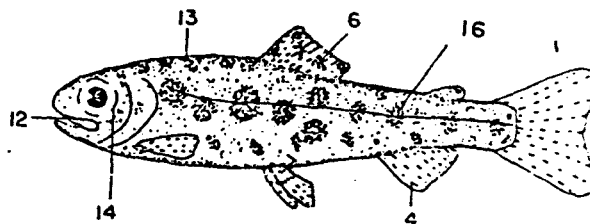
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.

Cutthroat trout
(*Salmo clarki*)



16. (20) Parr marks almost round.
Rainbow or steelhead trout
(*Salmo gairdneri*)

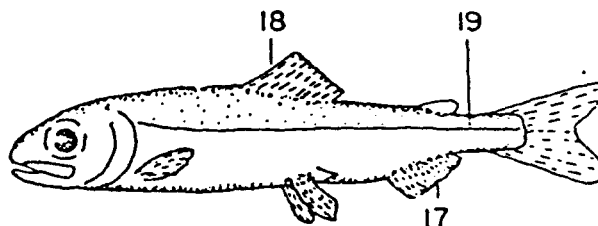


17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2E)
18. (6) Dorsal fin without large dark spots, may be black tipped.

Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.

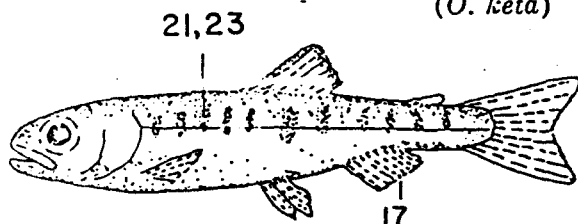
Pink salmon
(*O. gorbuscha*)



12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

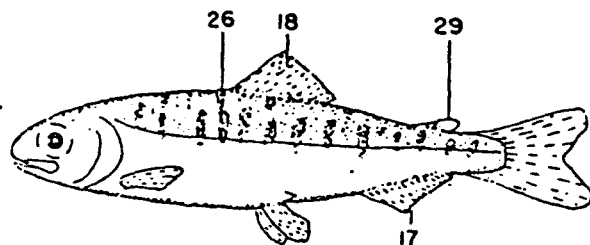
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26.
** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



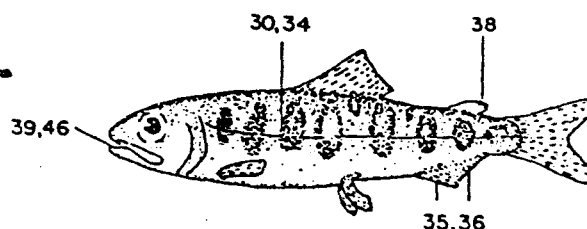
25. (22) Gill rakers on first arch, 30 to 40.
**Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



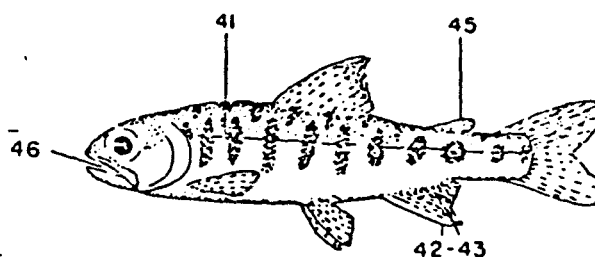
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Pyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Pyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



47. (1) Adipose fin not present; scales present or lacking.
Not Salmonidae
48. (2) No fleshy appendage at base of pelvic fins.
Smelts
Family Osmeridae
49. (3) Mouth small, not reaching center of eye; teeth weak or absent.
50. (51) Depressed dorsal fin, shorter than head.
Whitefishes
Genus *Coregonus*
51. (50) Depressed dorsal fin, longer than head.
Arctic grayling
(*Thymallus arcticus*)
52. (5) **Teeth on head of vomer only. -
Charrs
Genus *Salvelinus*
Dolly Varden (*S. malma*)
53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.
Brown trout
(*Salmo trutta*)

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APPENDIX B

Fishpass Maintenance and Operation

Initial maintenance of the fishpass will be completed prior to 1 June to insure proper functioning of the facility.

Maintenance consists of:

1. Thorough inspection of the fishpasses for structural damage.
2. Replacement of tank covers (all weather wood staged at lake).
3. Cleaning of debris from fishpass tanks and runs.
4. Attachment of rubber bumpers on ends of fishpass and inside tanks.
5. Regrouting and placement of plywood collars around entrance and exit chutes (old fishpass).
6. Cleaning entrance tanks, installation of wings and attachment of astroturf mats.
7. Clearing rocks and streambed materials from exit tank, channel, stop-log base of water control weir, and entrance tanks.

Fishpass opening procedures:

1. Wood drain plugs inserted from inside tanks into drain holes. Plugs should fit tightly, so that internal tank water pressure holds plug in place. Install tank caps screwed on from outside.
2. Tank covers positioned and stop-logs removed slowly from exit tank. Bottom stop-log remains in place. Note that if stop-logs are removed rapidly gravel is deposited into tank.
3. Make sure no holes are present where fish could escape uncounted.
4. Install heavy gauge vinyl wire across front of water control weir which prevents fish from washing over falls, attach so that screen is secure on substrate and does not lift off bottom.

The fishpass will be operated so that steepass is about 3/4 full of water. This volume is necessary to attract sockeye salmon to the entrance tank and promote optimum fish passage. A water level of 1.8-1.9 feet should be maintained on the staff gauge by removing or placing stop logs at the water control diversion (top of falls). At this level the old fishpass will be 3/4 full.

A 9-inch (23 cm) wide vertical slot "door" is placed at the entrance tank during most of the annual sockeye run. This door will be checked daily during fish passage to assure it is completely down. It can open when sockeye hit against it, so diligence is necessary. The opening space (23 cm) is needed to maintain velocity for fish attraction. The door can be opened to 1 foot (30 cm) at seasons end to further attract fish.

The fishpass will be checked daily for cover tightness and unobstructed water flow. Under no circumstances should obstructive materials be placed in the exit tank or steeppasses.

Avoid allowing detergents or chemicals from entering the fishpass water supply. Visitors and all other personnel will not be allowed on the fishpass nor interfere with salmon passage.

Fishpass closing procedures (approximately 25 August):

1. Remove stop-logs from water control weir and stack on bank, replace stop-logs in exit tank. Visqueen as necessary to stop water flow between logs.
2. Remove all drain caps by unscrewing and lightly tapping them from outside tanks, store caps and plugs in tractor shed. All water should be drained from tanks. All residual materials within tanks should be removed.

3. Remove vertical slot door and store in tractor shed while replacing it with a solid door to prevent unwanted visitors entering.
4. Inspect fishpass and facility for needed repairs and list including inventory, and needed materials in the daily log/annual report. Also include fuel caches and propane so that we know what is left behind.
5. When lower weir is removed, panels will be stored on the lower stream bank. Bolts on the weir should be tightened and replaced if necessary. Catwalk and stringer materials should be inspected and replaced if required. Add lumber needs to materials list.

APPENDIX C

Procedure for Sampling Adult Salmon For Age, Length, and Sex

Annually, salmon escapements and catches are sampled for age (scales), length, and sex (ALS) by field crews throughout the state. This database is essential for sound management of the State's salmon resources.

To be useful, data must be recorded on the mark-sense (AWL) forms neatly and accurately. Scale samples must be collected and mounted properly to ensure accurate age determination. The following procedures are to be adhered to when sampling for age, length, and sex.

COMPLETING THE AWL FORMS:

A completed AWL form and accompanying gum card for sampling sockeye and chum salmon are shown in Appendix C.1.. Similar examples for sampling chinook and coho salmon are shown in Appendix C.2.

Complete each section of the left side of the AWL form using a No. 2 pencil and darken the corresponding blocks as shown in the figures. Make every effort to darken the entire block as partially filled blocks are often missed by the optical scanner which reads and records the data from the AWL forms. Label only one form at a time to avoid a "carbon paper effect" resulting in stray marks.

Description:

Record the following: species/area/catch or escapement/gear type (seine, weir, etc.)/samplers

Card:

The AWL forms and corresponding gummed card(s) are numbered sequentially by date throughout the season starting with 001. A separate numbering sequence will be used for each species, district, and geographic location. Consult your port supervisor for the current card number. Sockeye and chum scale samples will have only 1 gum card per AWL form as shown in Appendix C.1. Coho and chinook samples will use up to four gum cards per AWL form as shown in Appendix C.2.

Species:

Refer to the reverse side of the AWL form for the correct digit.

Day, Month, Year:

Use appropriate digits for the date the fish are caught.

District:

List only one district. Consult area statistical map or project leader for appropriate district.

Subdistrict (Section):

List a single subdistrict if it is known and if all the potential samples were caught in that section. If more than one section is involved, list each section but do not darken the corresponding blocks. Leave blank if the section is unknown.

Stream:

Leave blank for catch sampling; escapement sampling consult area statistical map for appropriate stream number.

Location:

List the appropriate code as shown on Appendix C.3.

Period:

List the period in which the fish were caught (Appendix C.4.).

Project and Gear:

Refer to the reverse side of the AWL form for the correct code.

Mesh:

Leave blank unless specifically instructed by supervisor to do otherwise.

Type of length measurement:

Use (2) mid-eye to fork-of-tail. Refer to Appendix C.5.

of cards:

Mark 1 (each AWL form in individually numbered) when sampling sockeye, chum, coho, and chinook salmon.

Keep the litho codes in numerical order throughout the season and keep the AWL forms flat, dry, and clean. Fish gurry and water curling will cause data to be misinterpreted by the optical scanning machine. It is the crew leaders responsibility to make sure that all forms are carefully edited before returning them to your supervisor.

GUMMED CARDS:

Fill out the gum cards as shown in Appendices C.1 and C.2.

Species:

Write out completely (i.e., chinook, sockeye, etc.).

Locality:

For catch and escapement sampling, write down the area in which fish were caught, followed by catch or escapement (e.g. Karluk River escapement; Uganik Bay catch).

Stat. code and Sampling date:

Transfer the appropriate digits from the AWL form.

Gear:

Write out completely.

Collector(s):

Record the last names of person(s) sampling.

Remarks:

Record any pertinent information such as number of scales per fish sampled, vessel/tender name, etc. Transfer this same information to the top margin of the AWL.

SAMPLING PROCEDURE:**A. GENERAL**

1. Place the fish on its right side to sample the left side.
2. Determine sex of the fish and darken M or F in the sex columns. If any difficulty is encountered with this procedure, write "I had trouble sexing these fish" on the top margin of the AWL and ask your supervisor for help as soon as possible before sexing additional fish.
3. Measure fish length in millimeters from the mid-eye to fork-of-tail (Appendix C.5.) Record length by blackening the appropriate column blocks on the AWL form. Column 3 on the AWL form is used for fish with a length greater than 999 millimeters (Chinook). Measure all species of salmon to the nearest mm. Check the calipers periodically to ensure measurement accuracy.
4. Remove the "preferred scale" from the fish by grasping its exposed posterior edge with forceps and pulling free. Remove all slime, grit, and skin from the scale. The "preferred scale" is located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Appendix C.6.). If the "preferred scale" is missing, select a scale within the preferred area on either the left or right side of the fish. If no scales are present in the "preferred area" on either side of the fish, sample a scale as close to the preferred area as possible and darken the 8 under "age error code" on the AWL form. Do not select a scale located on the lateral line.
5. It is important to take care that scales adhere to the card, rough side up. Therefore, without turning the forceps over, clean, moisten, and mount the scale on the gummed card with your thumb or forefinger. Exert just enough pressure to spread and smooth the scales directly over the number as shown in Appendix C.6. The ridges on the sculptured side can be felt with a fingernail or forceps. Mount scale with anterior end oriented toward top of gum card. All scales should be correctly oriented on the card in the same direction (Appendix C.7).
6. When sampling sockeye and chum salmon, repeat steps 1 through 4 for up to 40 fish on each AWL form.
7. When taking multiple scales per fish as with chinook and coho salmon, sample the "preferred scale" and scale #2 as shown in Appendix C.6. Scale #2 is one inch to the left of the "preferred scale," and is 2 rows above the lateral line. Mount the 2 scales from fish #1 over 1 and 11 on the gum card as shown in Appendix C.2. Continue to mount the 2

scales from fish #2 over 2 and 12, etc. If sampling 3 scales, mount the scales over #1, #11, #21, etc.

8. When sampling at weirs you may use write in rain books to record the data. Keep the mark-sense forms in camp where they will be clean, dry, and flat. After sampling is done for the day transfer the data to the mark-sense forms. **It is the responsibility of the crew leader to be sure the data has been transcribed correctly and the AWL forms filled out completely.**

SCALE SAMPLING CHECKLIST

OPERATIONAL PLAN	PENCILS (NO. 2)
GUM CARDS	FORCEPS
AWL FORMS	PLASTIC CARD HOLDERS
CALIPERS	CLIPBOARD

SOME REMINDERS

1. For greater efficiency in scale reading and digitizing, mount scales with anterior end toward top of scale card.
2. AWLs should be carefully edited. Re-check header information on AWLs; make sure all available information is filled in. Take extra care to use the correct period code for the sampling or catch date. AWL numbers should not be repeated; a frequent error is to begin a week's sample with the last AWL number used the week before. This is particularly important if the data is regularly sent to town; it is easy to forget which AWL numbers were used. Crew leaders should take time to ensure that the boxes are being blackened correctly, if the boxes are sloppily marked the optical scanner records the information incorrectly or misses it entirely. Keep pencil marks within each block, filling it completely.
3. Transfer important comments from scale cards to AWLs. After pressing scales, the cards are seldom referred to again, and important remarks can be lost. Write comments in the top right margin. If there is not room on the AWL to completely explain the remarks, use a separate piece of paper.
4. Never put data from different dates on one AWL or one scale card. Even if only one scale is collected that day, begin a new AWL and gum card the next day.
5. If weights are taken, they may be noted in the right margin of the AWL during sampling, but be sure to transfer the weights and litho code to the appropriate columns on the reverse of the AWL before submitting it to your supervisor.

6. The data processing program uses the "litho code" on the AWL. (It is located in the lower left margin of the AWL.) Try to keep the litho codes in numerical order. This should not be hard to do if they are arranged that way before page numbering. Those who sample different areas throughout the season can arrange the litho codes in order before each sample is taken.
7. If AWLs get wrinkled or splotted they should be transcribed onto a new AWL prior to sending in. The optical scanning computer will misread or reject wrinkled sheets. Do not use paperclips on AWL forms.
8. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.) Glue often obscures scale features and scales frequently adhere poorly to wet card. Protect the cards, keep them dry to avoid having to remount the scales on a new card.
9. Scan the AWL form for mistakes. A common error occurs, for instance, in placing both the 4 and 7 of a 475mm fish in the 100's column with nothing in the 10's column.
10. Record all comments explicitly on the gum card under remarks and transfer remarks to the top margin of the AWL form.
11. Responsibility for accuracy lies first with the primary data collector(s). The port supervisor will return sloppy or incomplete data to individual collectors for correction.

Species: SOCKEYE Card No. 001
 Locality: AKALURA ESC.
 Stat. Code: 257-30-302
 Sampling Date: Mo. 08 Day 16 Year 91
 Gear: BEACH SEINE
 Collector(s): HICKS KAPLAN PEARSON
 Remarks: _____

19	9	8	7	6	5	4	3	2	1
20	19	18	17	16	15	14	13	12	11
30	29	28	27	26	25	24	23	22	21
40	39	38	37	36	35	34	33	32	31

SAMPLES = HICKS, KAPLAN, PEARSON(R)

DESCRIPTION: SOCKEYE/AKALURA/ESC.

ADFG ADULT SALMON AGE-LENGTH
FORM VERSION 2.1

CARD: 001

SPECIES: 2

DAY: 16

MONTH: 09

YEAR: 91

DISTRICT: 257

SUBDISTRICT: 30

STREAM: 302

LOCATION: AKALURA

PERIOD:

PROJECT: 3

GEAR: 2

MESH:

TYPE OF LENGTH MEASUREMENT: 2

NUMBER SCALES/FISH: 1

OF CARDS: 1

SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1					
2					
3					
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DO NOT WRITE IN THIS MARGIN

229518

litho code



SPECIES

- 1 - Chinook (king)
- 2 - Sockeye (red)
- 3 - Coho (silver)
- 4 - Pink (humpy)
- 5 - Chum (dog)

PROJECT

- 1 - Commercial catch
- 2 - Subsistence catch
- 3 - Escapement (tumor, weir, sonar site, etc)
- 4 - Escapement - spawning grounds
- 5 - Test fishing
- 6 - Sport catch (marine)
- 7 - Sport catch (freshwater)

GEAR TYPE

- 8 - Trap
- 9 - Purse seine
- 10 - Beach seine
- 11 - Herring purse seine
- 12 - Handpicked
- 13 - Dip net
- 14 - 16 Unassigned
- 15 - Troll
- 16 - Beam trawl
- 17 - Long line
- 18 - Shovels
- 19 - Weir
- 20 - 99 Unassigned
- 9 - Pots
- 18 - Sport hook and line

Species: COHO Card No: 001A
 Locality: KARLUK ESC
 Stat Code: 255-10-101-
 Sampling Date: Mo 08 Day 29 Year 91
 Gear: WEIR / TRAP
 Collector(s): T. STACK, S. BROWN, J. FOX
 Remarks: 2 SCALES / FISH

card: 001A

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

DESCRIPTION: COHO / KARLUK / ESC
2 SCALES / FISH

SAMPLERS:
T. STACK - W
S. BROWN - S
J. FOX - R

ADF&G ADULT SALMON AGE-LENGTH
 FORM VERSION 2.1

CARD: 001A+B

SPECIES: COHO

DAY: 29

MONTH: 08

YEAR: 91

DISTRICT: 255

SUBDISTRICT: 10

STREAM: 101

LOCATION: 35

PERIOD: -

PROJECT: ESC

GEAR: WEIR / TRAP

MESH: -

TYPE OF LENGTH MEASUREMENT: 2

NUMBER SCALES / FISH: 2

OF CARDS: 1

SEX	100's	LENGTH	1's	AGE GROUP	AGE ERROR CODE
1					
2					
3					
4					
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DO NOT WRITE IN THIS MARGIN

216854

NCS DOCUSCAN MB20-17877-109 AS200

Species: COHO Card No: 001B
 Locality: KARLUK ESC
 Stat Code: 255-10-101-
 Sampling Date: Mo 08 Day 29 Year 91
 Gear: WEIR / TRAP
 Collector(s): T. STACK, S. BROWN, J. FOX
 Remarks: 2 SCALES / FISH

card: 001B

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

Appendix C.2. AWL and scale cards for sampling 2 scales per fish.

Appendix G.3. Assigned port and weir location codes.

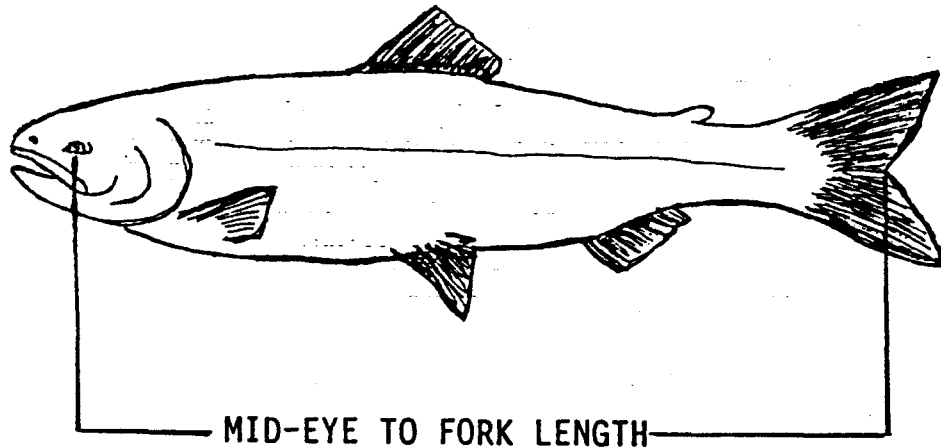
Port and Location Codes

030 - Lazy Bay
031 - Port of Kodiak
032 - Pauls Lake
033 - Thorshiem
034 - Afognak River
035 - Karluk River
036 - Red River
037 - Upper Station
038 - Frazer Lake
039 - Dog Salmon
040 - Akalura River
041 - Uganik River
042 - Malina Creek
150 - King Cove
151 - Port Moller
052 - Dutch Harbor
053 - Akutan
054 - Sand Point
055 - Bear River, ADF&G Camp
056 - Nelson River, ADF&G Camp
057 - Canoe Bay

Appendix C.4. Periods and corresponding calendar dates, 1993.

Period	Calendar Dates	Period	Calendar Dates
1	01-Jan to 03-Jan	28	05-Jul to 11-Jul
2	04-Jan to 10-Jan	29	12-Jul to 18-Jul
3	11-Jan to 17-Jan	30	19-Jul to 25-Jul
4	18-Jan to 24-Jan	31	26-Jul to 01-Aug
5	25-Jan to 31-Jan	32	02-Aug to 08-Aug
6	01-Feb to 07-Feb	33	09-Aug to 15-Aug
7	08-Feb to 14-Feb	34	16-Aug to 22-Aug
8	15-Feb to 21-Feb	35	23-Aug to 29-Sep
9	22-Feb to 28-Feb	36	30-Aug to 05-Sep
10	01-Mar to 07-Mar	37	06-Sep to 12-Sep
11	08-Mar to 14-Mar	38	13-Sep to 19-Sep
12	15-Mar to 21-Mar	39	20-Sep to 26-Sep
13	22-Mar to 28-Mar	40	27-Sep to 03-Oct
14	29-Mar to 04-Apr	41	04-Oct to 10-Oct
15	05-Apr to 11-Apr	42	11-Oct to 17-Oct
16	12-Apr to 18-Apr	43	18-Oct to 24-Oct
17	19-Apr to 25-Apr	44	25-Oct to 31-Oct
18	26-Apr to 02-May	45	01-Nov to 07-Nov
19	03-May to 09-May	46	08-Nov to 14-Nov
20	10-May to 16-May	47	15-Nov to 21-Nov
21	17-May to 23-May	48	22-Nov to 28-Nov
22	24-May to 30-May	49	29-Nov to 05-Dec
23	31-May to 06-Jun	50	06-Dec to 12-Dec
24	07-Jun to 13-Jun	51	13-Dec to 19-Dec
25	14-Jun to 20-Jun	52	20-Dec to 26-Dec
26	21-Jun to 27-Jun	53	27-Dec to 31-Dec
27	28-Jun to 04-Jul		

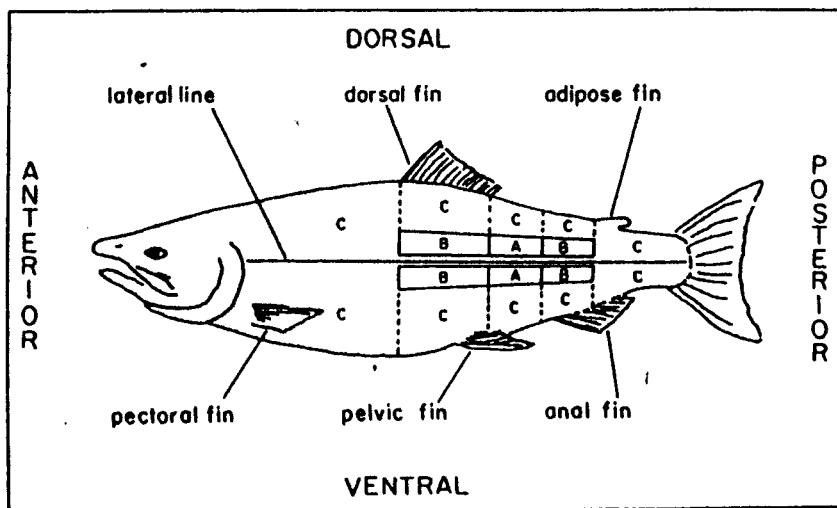
Appendix C.5 Measuring fish length, mid-eye to fork of tail.



Mid-eye to fork lengths are taken because the length and shape of a salmon's snout changes as it approaches sexual maturity. The procedure for measuring by this method follows:

- 1) Place the salmon flat on its right side, with its head to your left and the dorsal fin away from you.
- 2) The eye should be on the line projecting from the end of the meter stick. Hold the head in place with your right hand. Sometimes you can control the fish better by placing your thumb in the fish's mouth.
- 3) Flatten and spread the tail against the board with your right hand.
- 4) Read the mid-eye to fork length to the nearest millimeter.

Appendix C.6. Removal and mounting of the preferred scale.

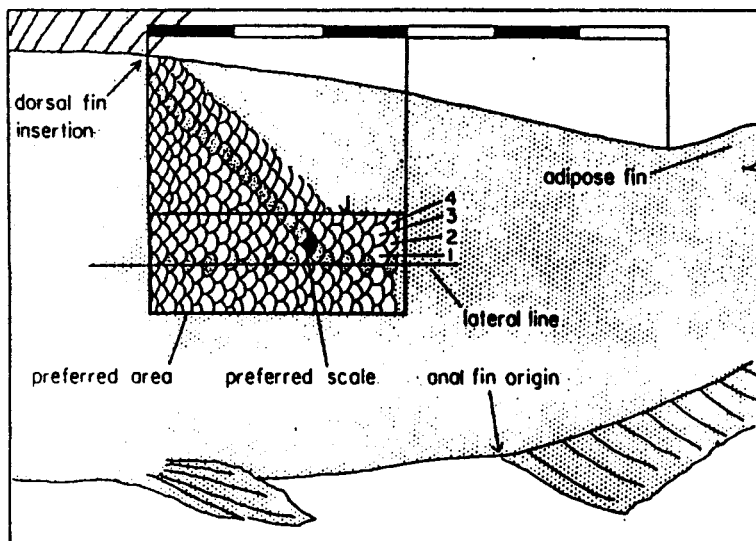


INPFC rated areas for scale removal.

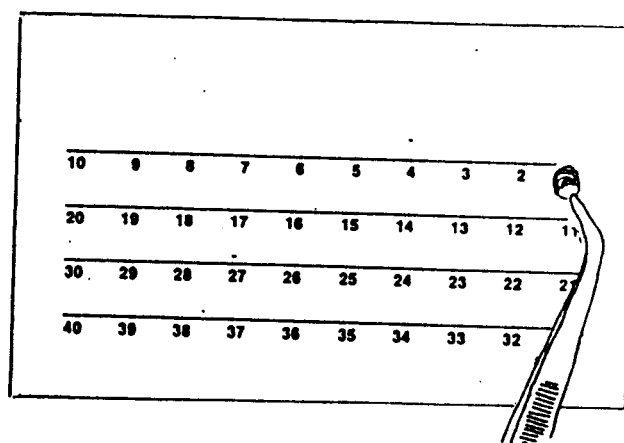
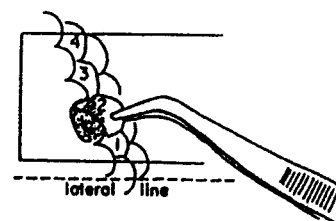
Area A is the preferred area. B is the second choice if there are no scales in area A.

C designates non preferred areas. If scales on the left side of the fish are not good, try the right side.

DO NOT TURN SCALE OVER

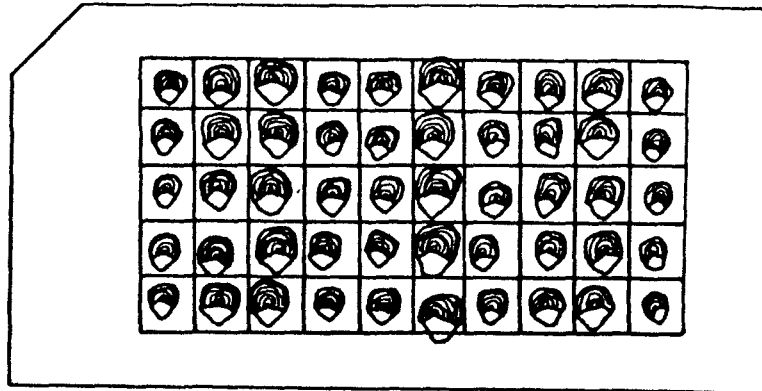


The preferred scale in this diagram is solid black. It is located 2 rows up from the lateral line, on a diagonal from the insertion (posterior) of the dorsal fin "back" towards the origin of the anal fin.

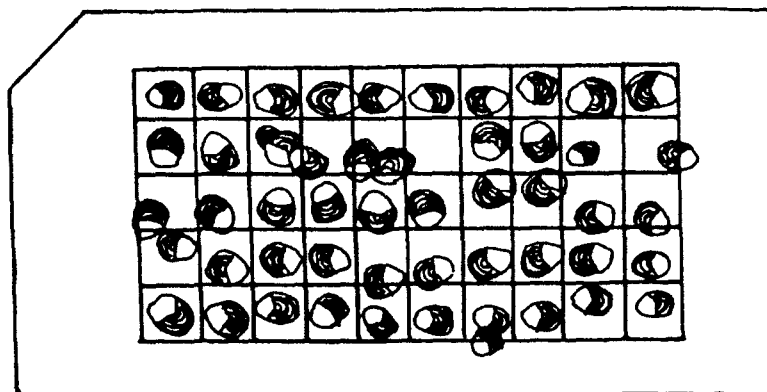


Place the scale directly over the number on the gummied card with the anterior portion (arches of the scale pointed toward the top of the card.

Appendix C.7. Scale orientation on the gummed card.



The scales are all correctly oriented on the card in the same direction, with the anterior portion of the scale pointed toward the top of the card.



The scales are incorrectly oriented in different directions. This increases the time spent to age samples.

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